PART III
The World of Archaeology

The basic materials of archaeology, and the methods available for establishing a space–time framework, were reviewed in Part I of this book. The range of questions we can ask of the past, and the techniques available for answering them, were surveyed in Part II. Here, in Part III, our aim is to see how these various techniques are put into practice. In an actual field project one would like, of course, to answer all the questions at once (no archaeologist ever set out to answer just one of them without at the same time coming up with observations relevant to others).

In Chapter 13, four selected case studies show how several questions can be addressed at once. In a regional study we are concerned with the location of the relevant evidence, with establishing the time sequence of the remains discovered, with the investigation of the environment, with the nature of the society, and indeed with the whole range of issues raised in the various chapters of this book. Any director of a major project has, in a sense, to reach a compromise in order to be able to follow up several avenues of inquiry simultaneously. The aim here is to illustrate with informative examples how such compromises have indeed been reached in practice, with a fair degree of success. Thus we hope to give something of the flavor of archaeological research in practice.

An archaeological investigation, even on a regional scale, cannot, however, be considered in isolation. It is only one part of the world of archaeology, and hence of society as a whole. The last chapter in this book is therefore devoted to public archaeology – to the ethical, practical, and political relationships that relate the archaeologist to society at large. The aim of archaeology, after all, is to provide information, knowledge, and insight into the human past. This is not for the benefit of the archaeologist alone but for society at large. Society finances the archaeologist, and, in the final analysis, society is the consumer. The relationship merits examination.

13 Archaeology in Action
Four Case Studies

In this volume we have sought to examine the various methods and ideas employed by archaeologists. We have tried to stress that the history of archaeology has been the story of an expanding quest, in which the finds made in the field can often be less important for progress than the new questions asked and the new insights gained. The success of an archaeological enterprise thus depends crucially on our learning to ask the right questions, and finding the most productive means of answering them.

It is for this reason that the chapters in this book have been organized around a series of key questions. Inevitably, that has meant focusing chapter by chapter on a number of different themes. But in reality the life of the archaeologist is not quite like that. For when you go out into the field with your research design, with the bundle of questions you would like to answer, you may in fact find something quite different from what you expected, yet obviously very important. The archaeologist excavating a multi-period site may be interested primarily in a single, perhaps early, phase of occupation. But that does not give him or her the right to bulldoze away the overlying levels without keeping any record. Excavation is destruction and (as we shall discuss in the final chapter) this brings to the archaeologist a series of responsibilities, some of them not always welcome, which cannot be avoided. The practice of archaeology, in the hard light of reality, is often very much more complicated – and therefore more challenging – than one might imagine.

This is particularly so at the organizational level. To undertake a project in the field takes money, and it is not the purpose of the present book to examine the funding or organization of such projects. Increasingly, as we review Chapter 14, archaeological sites are protected by law, and a permit from the relevant authorities will be needed in order to undertake fieldwork and to excavate. Then there is the task of recruiting an efficient excavation team. What about transport, lodging, and food? After the excavation, who is to write what part of the excavation report? Are the photographs adequate, have the finds been suitably illustrated by drawings, who will finance publication? These are the practical problems of the field archaeologist.

This book is primarily about how we know what we know, and how we find out – in philosophical terms, about the epistemology of archaeology. To complete the picture, it is important to see something of archaeology in action: to consider a few real field projects where the questions and methods have come together and produced, with the aid of the relevant specialisms, some genuine advance in our knowledge.

The questions we ask are themselves dependent on what, and how much, we already know. Sometimes the archaeologist starts work in archaeologically virgin territory – where little or no previous research has been undertaken – as for instance when the Southeast Asian specialist Charles Higham began his fieldwork in Thailand (see our third case study, Khok Phanom Di: the Origins of Rice Farming in Southeast Asia).

In the Valley of Oaxaca in Mexico, on the other hand – our first case study – when Kent Flannery and his colleagues began work two decades ago, little was understood of the evolution in Mesoamerica of what we would call complex society, although the great achievements of the Olmec and the Maya were already well known. The work of the Flannery team has involved continual formulation of new models. It represents an excellent example of the truism that new facts (data) lead to new questions (and new theories), and these in turn to the discovery of new facts.

Our second case study follows the research project of Rhys Jones and his associates in Kakadu National Park, northern Australia. Here the archaeologists worked closely with the legal owners of the region's sites, the Aborigines – an experience of growing relevance for all researchers in lands occupied by indigenous peoples (Chapter 14).

The transformation in our knowledge of prehistoric Australia and Southeast Asia over the course of the last 30 years has been one of the most exciting developments to have taken place in modern archae-

ology. The Kakadu and Khok Phanom Di projects, with their close integration of both environmental and archaeological studies, have played an important part in that transformation.

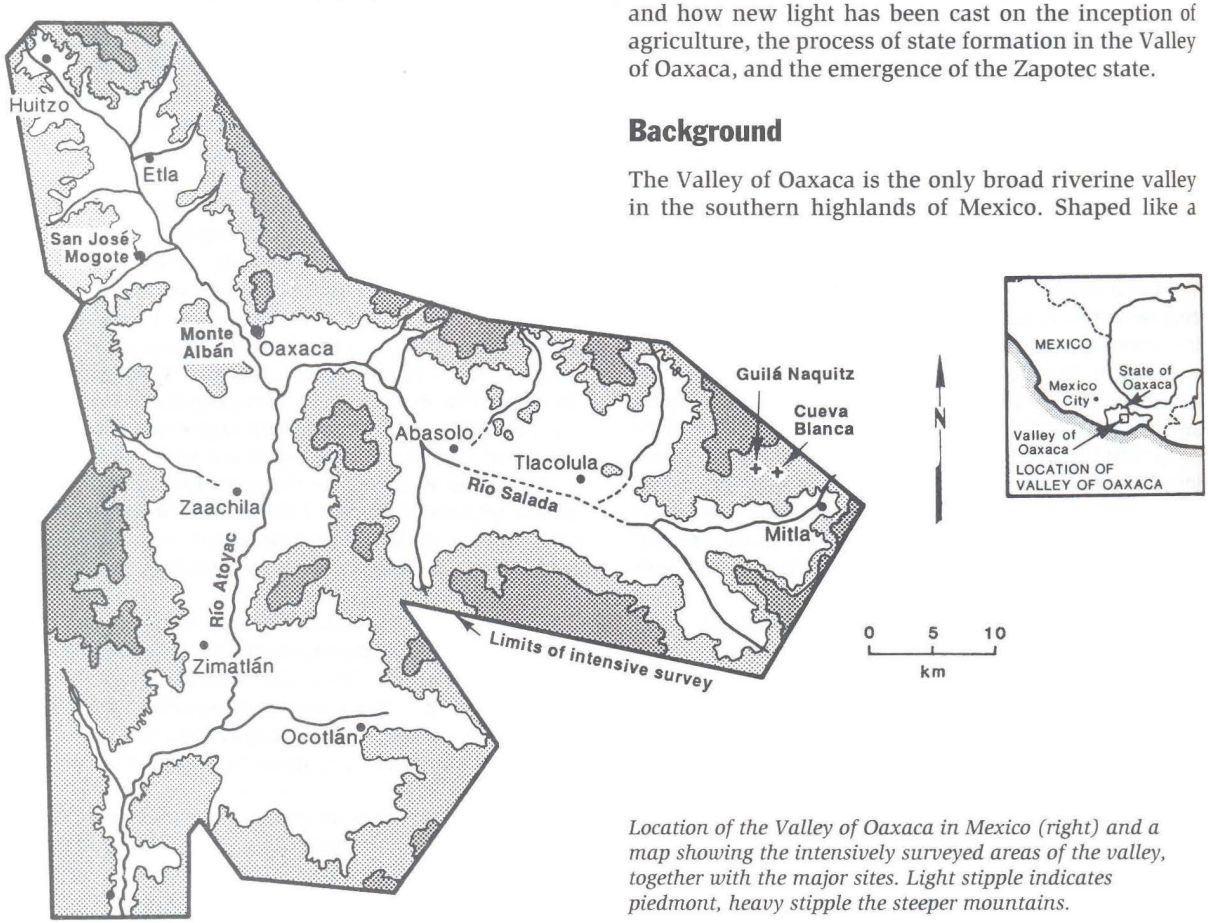
Our fourth case study focuses on the work of the York Archaeological Trust in the English city of York. This is a project of a very different kind: working under all the constraints of archaeology in a modern urban setting, the York unit has set out to present its findings to the public in a novel and effective way, and the Jorvik Viking Centre has for the past 15 years led the way in this aspect of public archaeology.

THE OAXACA PROJECTS: THE ORIGINS AND RISE OF THE ZAPOTEC STATE

The Valley of Oaxaca in the southern highlands of Mexico is best known for the great hilltop city of Monte Albán, one-time capital of the Zapotecs and famous for its magnificent architecture and carved stone slabs. Here, from 1930 onward, 18 seasons of fieldwork by the great Mexican archaeologist Alfonso Caso first laid the foundations of the region's time sequence. In recent decades, however, research has broadened to encompass the whole valley. There have been two major, long-term and complementary projects. The first, led by Kent Flannery from 1966 to 1973 and directed by him and Joyce Marcus from 1974 to 1981, has concentrated on the earlier periods – before Monte Albán's heyday – with the aim of elucidating the origins of agriculture and evolution of complex society in the region. The second project, conducted by Richard E. Blanton, Stephen Kowalewski, and Gary Feinman, has focused on the later periods dominated by Monte Albán. In what follows we shall look at the work of both projects down to the end of the Formative period (*c.* AD 100), and how new light has been cast on the inception of agriculture, the process of state formation in the Valley of Oaxaca, and the emergence of the Zapotec state.

Background

The Valley of Oaxaca is the only broad riverine valley in the southern highlands of Mexico. Shaped like a



Location of the Valley of Oaxaca in Mexico (right) and a map showing the intensively surveyed areas of the valley, together with the major sites. Light stipple indicates piedmont, heavy stipple the steeper mountains.

wishbone, it is drained by two rivers. Surrounded by mountains, it lies at an altitude of between 1420 and 1740 m (4658 and 5708 ft) and has a semi-arid, semi-tropical environment where rainfall fluctuates markedly – both predictably, between wet and dry seasons, and unpredictably from year to year.

Building on work by Ignacio Bernal, who had already catalogued many sites in the valley through survey, the Flannery-Marcus project began by surveying and locating as many early sites as possible in selected areas, before deciding on those to be excavated. In fact, survey still continues to reveal sites in the area as land clearance and canal building expose buried horizons. Survey from the air has been particularly helpful, since one can see through the sparse vegetation and identify small details almost to the level of individual trees.

Guilá Naquitz and the Origins of Agriculture

One excavation, designed to clarify the transition from foraging to food production, was that of a small rockshelter, Guilá Naquitz (White Cliff).

Survey and Excavation. Surface collection of artifacts from more than 60 caves in the same area suggested that four, including Guilá Naquitz, had enough preceramic material (such as projectile points) and depth of deposit (up to 1.2 m or 3 ft 9 in) to warrant full excavation. After access for transport to the site had been improved, test excavations were carried out to determine the stratigraphic sequence, establish whether preceramic levels were present *in situ*, and assess how far back in the sequence plant remains might be preserved. The stratigraphy was complex, but very clear because of dramatic color changes.

Work in progress inside Guilá Naquitz rockshelter, 1966. Zapotec Indian workmen from Mitla, Oaxaca, are excavating level D (the first level to include evidence of domestic plants).

It was to be expected that survival of food remains would be good, because the site is located in the driest part of the Valley of Oaxaca. The Flannery-Marcus team indeed found that preservation was outstanding, but the low densities of artifacts meant that all or most of the small cave would have to be dug in order to establish the nature of the tool assemblage. In the end, the entire area of preceramic occupation under the cave's overhang was removed through the excavation of 64 one-meter squares. Thorough screening and sieving techniques ensured that even the smallest items were recovered.

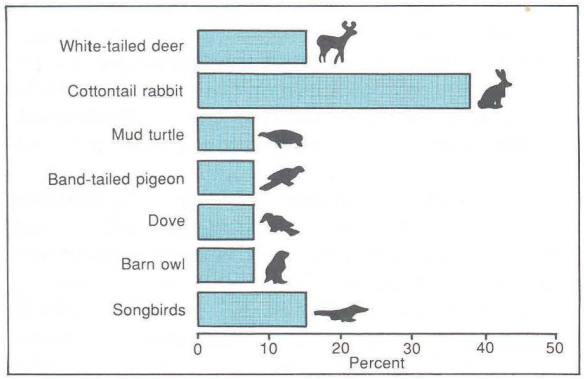
Dating. Radiocarbon dates obtained from charcoal found at Naquitz showed that its preceramic living floors extended from about 8750 to 6670 BC (there was also a little Formative and Postclassic occupation, not yet fully analyzed and published). The date of 8750 BC is close to the supposed transition from the Paleo-Indian period, characterized by extinct Pleistocene fauna, to the early Archaic, with Holocene fauna.

Environment. Analysis of pollen samples from the different levels provided a sequence of change for the area's vegetation with fluctuations in thorn, oak, and pine forest, and the possible utilization of cultivated plant resources from about 8000 BC onward, together with the collection of wild plant resources from the start of the sequence.

The microfauna recovered – rodents, birds, lizards, landsnails – were compared with their modern representatives in the region in order to cast further light on the preceramic environment, which was found to be not vastly different from that in existence today except for humanly induced changes. The present landscape is thus relevant to any interpretation of the past.

Diet. Rodents had been very active in the cave, gnawing nuts and seeds, so that it was vital to establish from the start how many of the food resources had been introduced to the site by people. Burrows were very visible in the living floors, and their contents could be examined. None of the commonly gnawed items such as acorns or nuts were found inside them. In addition, the distribution of plant species on the floors showed

Plant	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	No. of grams consumed	No. of Kilocalories represented
acorns													629	1812
agave													140	176
nopales													97	12
guaje seeds													54	19
nanches													30	21
mesquite pods				pods			stored seeds						14	42
hackberries													13	4
opuntia fruits													12	9
susi nuts													5	30
beans			flowers			seeds							3	4
piñon nuts													1	6
wild onions			flowers						bulbs				1	0
cucurbit					flowers		seeds						1	4



(Top) At Guilá Naquitz plants dominated the diet, especially acorns, agave, and mesquite pods and seeds. The site was occupied mainly from August (mesquite harvest) till early January (end of acorn harvest). (Above) Animals consumed.

a human pattern of large discard areas rather than the small pockets characteristic of rodent caches. Some plant remains also showed signs of food preparation. In short, the researchers could be confident that almost all the food resources in the site had been introduced by people.

Unfortunately, the six coprolites obtained from the preceramic levels all appeared to be from animals (probably coyote or fox). However, these creatures had probably scavenged food from the cave, and so the roasted plant remains (prickly pear and *agave*) in their feces provided clues to the human diet.

Clearer indications of diet were obtained through a combination of methods. These included data on plant and animal remains; modern plant censuses that provided information on the density, seasonality, and annual variations of various species in the area; and an analysis of the foods in the site from a nutritional point of view (calories, protein, fats, carbohydrates). The result was both a hypothetical diet for each living floor and an estimate of productivity of the Guilá Naquitz environment. Finally, all this information was pooled to reconstruct the "average diet" of the preceramic cave occupants and estimate the area needed to support them.

Over 21,000 identifiable plant remains were recovered, dominated by acorns, with *agave*, and mesquite pods and seeds. Dozens of other species were represented in small quantities. It thus became clear that, despite the wide variety of edible plants available, the occupants had adopted a selected few as staples. Acorns were probably stored after the autumn gathering for use throughout the year, because one of the major factors in life here is the great seasonal variation in the availability of different foods. It was found that the plant remains in each level reflected the harvest of an area from a few to a few hundred square meters.

Recently, some seeds of squash (*Cucurbita pepo*) from the site, which are morphologically domesticated, were directly dated by AMS to between 10,000 and 8000 years ago, which predates other domesticates in Mesoamerica (such as maize, beans, etc) by several millennia.

At least 360 identifiable fragments came from animals hunted or trapped for food. They were counted both as numbers of fragments (with the parts of the body and the position in the cave noted) and as minimum numbers of individuals (in order to estimate the amount of meat consumed or the territory needed to account for the remains). All the species are still common in the area today, or would have been common until the arrival of firearms. The major source of meat seems to have been the white-tailed deer.

The site catchment of Guilá Naquitz was calculated as follows: plant food requirements probably came from no more than 5–15 ha (12–37 acres); the deer from at least 17 ha (42 acres); and raw materials from up to 50 km (31 miles) away.

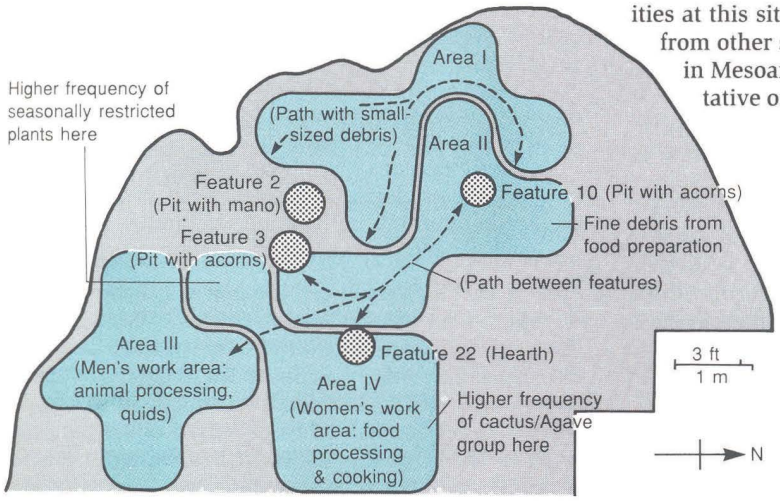
Technology. Being a small camp, Guilá Naquitz did not contain the full range of stone tools known from the preceramic in the Valley of Oaxaca generally. Of the 1716 pieces of chipped stone recovered from the preceramic levels, no fewer than 1564 lacked any retouch, implying that most had been used "raw," without being worked further. Almost every living floor had evidence for flake production, in the form of cores. Only 7 projectile points were found, setting in perspective the evidence from the animal bones and suggesting that hunting was not a major activity during the season the cave was occupied. Sidescrapers and knives may have been used in butchering or hide preparation. A survey of stone sources showed that the coarse material from which most tools were made was available within a few kilometers, but higher quality chert had occasionally been obtained from sources 25 and 50 km (15 and 31 miles) distant.

It is assumed that most of the grinding stones had been used for plant processing, since remains of food plants were found in the same levels. Textile materials also survived – netting, basketry, and cordage, including the oldest radiocarbon-dated examples from Mesoamerica (before 7000 BC) – and there were a few artifacts of wood, reed, or cactus as well, including materials for firemaking and toolhafting. Fragments of charcoal occurred here and there, and were used by the research team for radiocarbon dating or to determine the woods preferred as fuels by the cave's occupants. It was found that the choice of timber in the preceramic period had been wide-ranging, unlike that of the Formative villagers of the Oaxaca Valley who later showed a marked preference for pine which continued into the Colonial and modern eras and which probably explains the disappearance of that tree from some areas.

Social Organization and the Division of Labor. The distribution of material on the living floors was subjected to three separate computer analyses in order to assess activity areas and the organization of labor. The activity areas – clusters in the distribution – were defined on the basis of association: i.e. showing that an increase in one variable (such as nut hulls or hackberry seeds) is a good predictor of an increase or decrease in other variables. Hence the raw data consisted of the frequencies of different items per meter square of each floor, converted into density contour maps by computer.

When six living floors were analyzed, a number of repetitive patterns emerged that probably reflect regularities in the way tasks had been organized in the cave. These patterns are quite complex, and cannot be divided simplistically into men's and women's workspace. They include areas for light butchering, raw plant eating, toolmaking, meal preparation and cooking, and the discard of refuse. However, ethnographic research suggested some sexual division of work areas. Pathways into and within the cave were also isolated by the analyses.

Flannery and Marcus concluded that Guilá Naquitz was a small microband camp, used by no more than four or five people, perhaps a single family. It was occupied mainly in the fall, between late August/early September (the mesquite harvest season) and December/early January (the end of the acorn harvest season). Collecting wild plants was a major activity here, but hunting was less dominant than at other sites. Toward the end of preceramic occupation, there was a transition to food production. The full picture of activities at this site now has to be compared with results from other sites in this area and with other regions in Mesoamerica in order to assess how representative or unusual they are for their period.



Reconstructed activity areas and pathways of Zone D at Guilá Naquitz. Area I is interpreted as a curving pathway with acorn, hackberry, and flint debris. Another path, Area II, runs between acorn storage and food preparation areas. Area III may have been where animal processing was carried out by one or two people (probably men). Area IV may have been used by one or two people (probably women) to process and cook both seasonally restricted and cactus/agave group plants.

Why Did Things Change? In order to gain further insights into the process of adopting an agricultural way of life, Robert G. Reynolds designed an adaptive computer simulation model, in which a hypothetical microband of five foragers started from a position of ignorance and gradually learned how to schedule the gathering of the 11 major plant foods in the cave's environment by trial and error over a long period of time. At each step of the simulation the foragers were programmed to try to improve the efficiency of their recovery of calories and protein, in the face of an unpredictable sequence of wet, dry, and average years that changed the productivity of the plants.

Information on their past performance was fed back into the memory of the system, and affected their decisions about modifying strategy with each change. When the system reached such a level of efficiency that it could scarcely be improved, agricultural plants were introduced into the simulation and the whole process began again. Priorities were changed, and a new set of strategies developed. Changes in the frequency of wet, dry, and average years were also tried out, as well as alterations in population level.

The results of this model based on artificial intelligence theory, with its built-in feedback relationships, were that the hypothetical foragers developed a stable set of resource collecting schedules (one for dry and average years, the other for wet years) that closely mirrored those at Guilá Naquitz, as did the shifts in resource use that followed the introduction of incipient agriculture. No absolute time units were used in the simulation – we do not know how long a real-life group would actually take to achieve the same strategies. Nor was a "trigger" for agriculture, such as population pressure, introduced into the system. The resources were simply made available – as it were from a neighboring region – and adopted, first in wet years and later, when they proved reliable, in dry and average years.

When the simulated climate changed significantly, or population growth was introduced, the rate at which cultivated plants were adopted into the system actually slowed down. This suggests that neither climatic change nor population growth is necessary to explain the rise of agriculture in the Valley of Oaxaca. Rather, the work implies that a major reason for the adoption of agriculture was to help even out the effects of annual variation in food supplies, and was therefore merely an extension of the strategy already developed in pre-agricultural times.

The research project at Guilá Naquitz was fully published in 1986 in a volume edited by Kent Flannery after more than 15 years of analysis.

Village Life in the Early Formative (1500–850 BC)

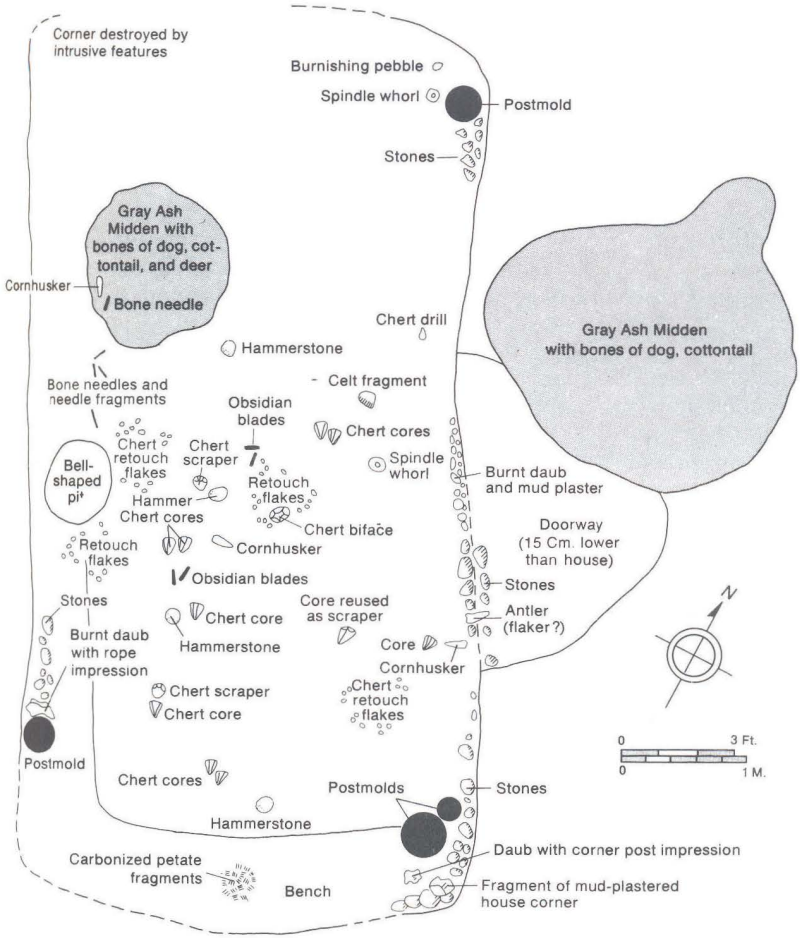
Another part of the project's work that has been published in some depth concerns Early Formative villages in the Valley of Oaxaca, the period when true, permanent settlements of wattle-and-daub houses first became widespread in the region. The project's aim was to construct a model of how the early village operated, and to do that it studied them at every level, from features and activity areas within a single house to household units, groups of houses, whole villages, all villages in a valley, and, finally, interregional networks within Mesoamerica.

Settlement and Society. As seen in Chapter 3, the Flannery team took care to obtain as representative a sample as possible for each level, in order to gain a clear idea of the range of variation in artifacts, activities, site-types, etc. Before the Oaxaca project, not a single plan of an Early Formative house had been published. The project has recovered partial or nearly complete plans of 30 houses, along with others from later phases. Using Naroll's formula (see pp. 452–53), it was estimated that these houses (15–35 sq. m or 161–376 sq. ft) were intended for nuclear families.

Activity areas were plotted for each house, and, through ethnographic analogy, tentatively divided into male and female work areas. After detailed analysis household activities were divided into three types:

1. *Universal activities* such as food procurement, preparation, and storage – as revealed by grinding equipment, storage pits, and jars, and food remains recovered by excavation, screening, and flotation; some tool preparation was also classed in this group.
2. Possible *specialized activities* – activities found at only one or two houses, including manufacture of certain kinds of stone and bone tool.
3. Possible *regional specializations* – activities found in only one or two villages within a region; these include production of some shell ornaments, or featherworking; saltmaking was limited to villages such as Fábrica San José near saline springs.

The project also produced the first maps showing the layout of a Formative village (principally that of Tierras Largas). Some evidence for differences in social status emerged, particularly at Santo Domingo Tomaltepec. Here one group of residences – deduced to be of relatively higher status – had not only a house platform built of higher-quality adobe and stone, but a greater quantity of animal bone, imported obsidian, and



Early Formative Oaxaca. (Left) Plan of a house at Tierras Largas, c. 900 BC, with certain artifacts plotted in position. (Above) Zapotec workmen pour a solution of ash, water, and sodium silicate into a brass carburetor-mesh screen. By "floating" the charcoal fragments out of ash deposits at Early Formative sites such as Tierras Largas, the project was able to recover charred maize kernels, beans, squash seeds, chilli pepper seeds, prickly pear seeds, and other food remains that were invisible to the eye while excavating.

imported marine shell than the area of wattle-and-daub houses deduced to be of lower status. Significantly, locally available (and therefore less prestigious) chert formed a higher proportion of the tools in the lower-status area. Other villages may have had a zone of public buildings, though zonation was less formal than that of Classic and Postclassic sites.

The Early Formative settlements showed considerable variation in size on the basis of site surveys. About 90 percent were small hamlets, of between one and a dozen households, up to 12 ha (29 acres) in size, and with up to 60 people. Most remained stable at that size for centuries, but a few villages grew bigger. San José Mogote reached 70 ha (172 acres) by 850 BC, the largest settlement in the Valley of Oaxaca at that time and the central place for a network of about 20 villages. Flannery and Marcus postulated that the spacing of the villages about 5 km or 3 miles apart was probably determined socially, to avoid overcrowding, rather than by environmental or agricultural factors, because the available arable land could easily have supported a closer grouping of sites. On the other hand, factors of site catchment determined the precise location for each settlement.

Catchment Areas and Trade. The catchment areas for several sites were assessed. San José Mogote could have satisfied its basic agricultural requirements in a radius of 2.5 km (1.5 miles); its basic mineral resource needs and some important seasonal wild plants within 5 km (3 miles); deer meat, material for house construction, and preferred types of firewood had to be fetched from within 15 km (9.4 miles). Trade with other regions brought in exotic materials largely from a radius of 50 km (30 miles), but sometimes from as far as 200 km (125 miles; see box, pp. 258–59).

Trade in obsidian seems to have taken the egalitarian form of exchange in the Early Formative, with all villages participating. From its various sources, it traveled along chain-like networks of villages, to be distributed among households in each community. Unmodified shell was brought in from the coast, and apparently converted into ornaments in the larger villages by part-time specialists who were also farmers, as suggested by the range of materials on their floors.

What Did They Think? What Were They Like? The Oaxaca Early Formative project also examined the evidence for religion and burial. From a study of context, ritual paraphernalia could be distinguished at three levels: the individual, the household, and the community.

At the *community* level, only certain villages had structures that were evidently public buildings rather than residences, and it is assumed that some of the activities carried out in them were ceremonial in nature, and presumably served the neighboring hamlets as well. Conch-shell trumpets and turtle-shell drums also probably functioned in ritual at the community level (local ethnography supports this view), and were brought in from the coastal lowlands.

At the *household* level, features such as enigmatic shallow, lime-plastered basins within houses have been interpreted as ritual, or at least non-utilitarian, as have figurines of ancestors and dancers in costumes and masks. The excavators now believe, based on ethnographic sources, that the basins were used for divination. After filling them with water, women tossed maize kernels or beans on the surface and interpreted the pattern. Ethnography and ethnohistory suggest that fish spines were used in personal rituals of self-mutilation and bloodletting; spines from marine fish were specially imported to the valley.

At the *individual* level, burials, like houses, suggest that ranking formed a continuum from simple to elaborate, rather than a rigid class system. The cemetery outside the village of Santo Domingo Tomaltepec had over 60 burials of 80 individuals, of whom 55 could be aged and sexed. There were no infants (these were usually buried near the house) and only one child. The oldest person was 50 years of age. Males and females were roughly equal in number, but most women had died between the ages of 20 and 29, while most men had survived into their 30s.

All the burials were face-down, and almost all faced east, most in the fully extended position. But a few males were flexed and, although they constituted only 12.7 percent of the whole cemetery, they had 50 percent of the fine burial vessels, 88 percent of the jade beads, and a high proportion of the graves covered by stone slabs. Clearly, this group had some kind of special status.

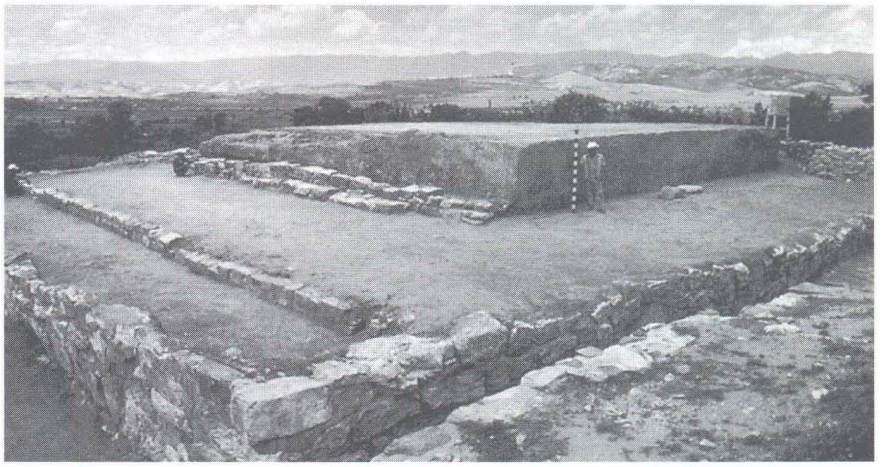
Social Developments in the Later Formative (850 BC–AD 100)

The research designs for the two long-term projects initiated by Kent Flannery on the one hand and Richard Blanton on the other had as their ultimate joint goal the identification of the processes leading to the rise of societies with hereditary ranking and to the evolution of the Zapotec state.

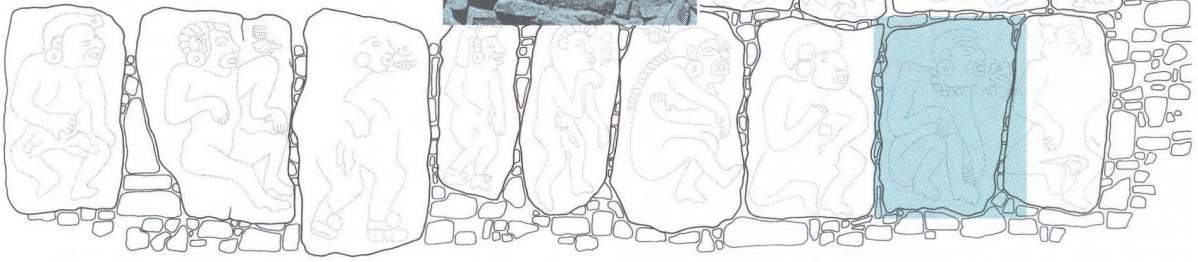
Richard Blanton, Stephen Kowalewski, Gary Feinman, and their associates conducted intensive, valley-wide settlement surveys using the survey methods originally pioneered in the Valley of Mexico, and then drew up settlement maps for successive phases. They also carried out a very detailed survey of the major site of Monte Albán. This, it turned out, had been a new foundation sometime around 500 BC, and the site had at once become the principal center in the region. Meanwhile, the excavations by Flannery and his associates already mentioned, at no fewer than nine village sites, provided evidence of the development of houses, storage pits, activity areas, burials, and other features throughout the Formative period. Subsistence was again a special focus of study through work with charred seeds, animal bones, pollen remains, and site catchment analysis.

Social organization was investigated by comparing residences from successive periods, by studying burials, and by considering public buildings in order to document the growth of various Zapotec state institutions out of the more generalized institutions of earlier times. Early Zapotec hieroglyphic writing was an important focus of study. And design element studies on pottery, undertaken by Stephen Plog, suggested that as complex regional networks of sites developed, certain groups of hamlets shared the services of a local civic-ceremonial center.

Already in the Early Formative period, as noted above, the site of San José Mogote had grown to preeminence in the valley. It was, however, in the succeeding Middle Formative period (850–500 BC) that a three-tier settlement hierarchy was observed through site survey. The site hierarchy was identified by size, and there are no clear indications of administrative functions. But the ceremonial functions are much clearer. San José Mogote reached its peak development as a chiefly center, a focus for some 20 villages, with a total population of perhaps 1400 persons. It boasted an acropolis of public buildings on a modified natural hill. An important find, from Monument 3, was a



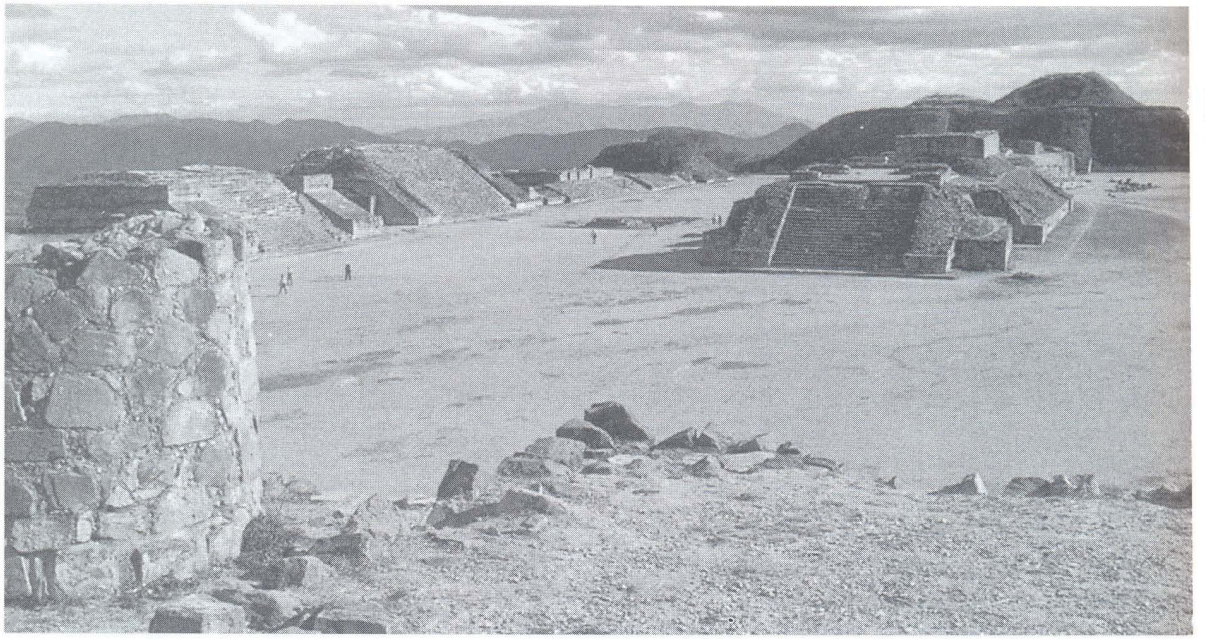
The danzantes ("dancers"), now interpreted as slain captives. (Above left) The origins of danzante carving can be traced to this figure from Monument 3 at San José Mogote, dating to the Rosario phase (600–500 BC). (Above right) San José's largest Rosario phase public building. The workman stands beside structure 28. (Right and below) Photograph of one of the Monte Albán danzantes, and a drawing that reconstructs their probable arrangement on Structure L at that site, c. 500–200 BC.



carved slab showing a sprawled human figure (see illus. above).

The carved slab is one of those discoveries which carries wide implications. For it anticipates 300 or more stone slabs carved with human figures found at Monte Albán in the succeeding phase – the so-called *danzantes*, now interpreted as depicting slain captives. To find a precursor at San José Mogote before 500 BC is therefore of particular interest. In addition it may be taken to imply the sacrifice of captives at this early time. Between the feet of the San José figure are signs that may be interpreted as giving the date or name-day "One Earthquake." This indicates that the 260-day calendar was already in operation at this time.

Monte Albán. The major site of Monte Albán was founded around 500 BC on a mountain not previously occupied. Richard Blanton has suggested that the site was selected as an administrative center precisely because it was on unoccupied, politically neutral ground in the "no man's land" between different arms of the valley. He suggests that its founding might be seen as the result of a confederacy among previously autonomous, and perhaps even competitive chiefdoms from various parts of the valley.



View south across the central plaza at Monte Albán, with the restored ruins of several temples visible. The site was founded on a mountain top in 500 BC.

This view is supported by the apparent cessation of monument construction at centers such as San José Mogote (the largest of them) and Huitzo at roughly the time that Monte Albán was founded. The deliberate fusing of different chiefdom territories in this way could be seen as the initial formation that later led to a state society, a society which continued without a break with Monte Albán as its capital until the demise of the Classic Zapotec state sometime after AD 700. By the time of Monte Albán phase II (200 BC–AD 100), the evidence for the Zapotec state is clear. Monte Albán had become a city with rulers living in palaces. Temples staffed with priests were to be found both here and at secondary and tertiary centers. Ceremonial inscriptions with multiple columns of texts appeared on buildings. These have been interpreted as listing the more than 40 places subjugated by Monte Albán.

This view of the emergence of the state throws the spotlight on the earlier phase I at Monte Albán, from 500 to 200 BC. But unfortunately at Monte Albán itself the evidence is not altogether clear. It can, however, be established that the site was a large one, ultimately by the end of phase I the home of some 10,000–20,000 people. The 300 *danzante* slabs belong to this phase. Fortunately the evidence from Monte Albán can be supplemented by indications from contemporary secondary centers, such as San José Mogote.

Conclusion

The key to this analysis of the emergence of state society in the valley of Oaxaca has been a sound chronology, based in the first instance on a study of successive pottery styles. Radiocarbon dates later provided an absolute chronology. The successive phases of settlement growth could then be studied.

One component in the success of the Oaxaca projects was the use of ***intensive field survey*** for settlements. In the end a complete survey of the valley was preferred to any sampling strategy. The second component was the ***ecological approach***, most crucial for the earlier periods when agriculture was developing, but important also in later phases, when systems of intensification such as irrigation were introduced. The emphasis on ***social organization***, using evidence from settlement hierarchy, differences in residences within settlements, and from burials, was a key feature. So too was modern cognitive-processual archaeology and the emphasis on ***religion and symbolic systems***. This is brought out by the books by Kent Flannery and Joyce Marcus and their colleagues: *The Cloud People* (1983) and *Zapotec Civilization* (1996), which also exemplify their commitment to the full and accessible publication of their research. The Oaxaca projects are thus of great interest for their methods as well as their results.

RESEARCH AMONG HUNTER-GATHERERS: KAKADU NATIONAL PARK, AUSTRALIA

In 1981–82, a team led by Rhys Jones of the Australian National University carried out a multidisciplinary research program inside Kakadu National Park in the Northern Territory of Australia. This World Heritage area is a tropical region, close to the north coast, and has been made internationally famous as the main location for the *Crocodile Dundee* movies. Few people realize, however, that in terms of the number of its occupied rockshelters and the profusion and probable antiquity of its rock art, Kakadu can be compared with such classic archaeological regions as southwest France.

Preparatory Work, and Aims of the Project

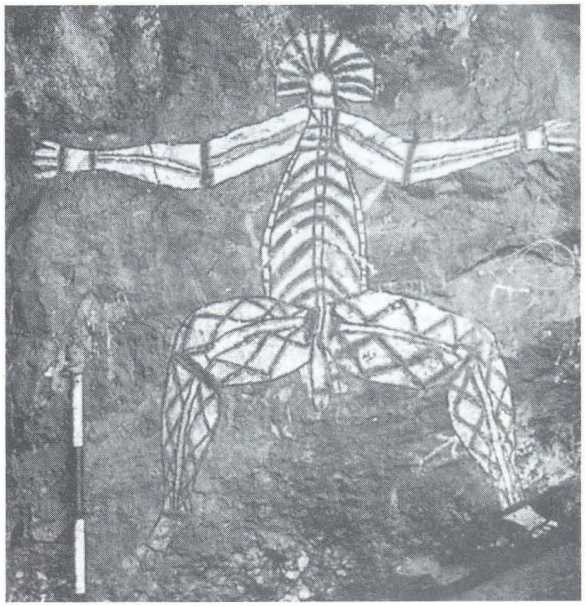
The project involved site survey and excavation in a variety of environments, building on previous work in this and neighboring areas. The first stage was to review all earlier archaeological studies in the area, from 1926 until 1979. These had included some site surveys, and excavations of rockshelters, shell mounds, and open-air sites, and had resulted in a basic knowledge of the stone-tool industries and the regional chronology. It had been revealed – particularly through the work of Carmel Schrire – that the occupation of tropical Australia could be traced back more than 23,000 years. One of the most startling discoveries had been the existence of edge-ground axes 20,000 years ago: at first, doubts were expressed about them by the international archaeological community, because in Europe the grinding of stone was a phenomenon associated with the much later Neolithic period.

In addition, investigation of the region's rock art by George Chaloupka had led him to the conclusion that the earliest art there (the "dynamic figure style") was as old as the Upper Paleolithic art of Europe. As we saw in Chapter 6, Chaloupka's art sequence is linked to environmental change in the region, and particularly to the progression of the sea up the river estuaries.

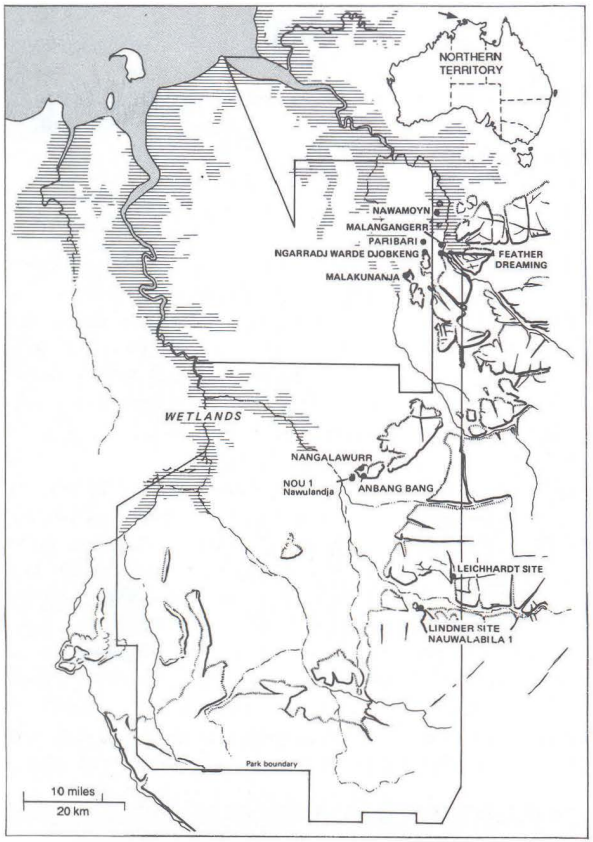
The new research program was designed to test and improve the results of previous work. More basic information was required for the stratigraphic and typological sequences, as well as for the chronology, including the date of the earliest occupation. In addition, it was necessary to investigate the relationship of the archaeological sequences to paleoenvironmental conditions, including the impact of the first inhabitants and their fires. It was also hoped to obtain a large amount of ethnographic information from the Aboriginal inhabitants of the area.

Collaboration with the Aborigines. Before any new fieldwork could be planned or carried out, it was imperative to consult the local Aboriginal community (see Chapter 14), explain and discuss the plans, and alter or abandon them if necessary. The Aborigines had traditional ties with the areas and specific sites in question, and were the legal owners. They took a keen interest in the details of the project. It was stressed to them that everything would be done openly and could be scrutinized at all times by members of their community. The Aborigines felt that the work should indeed be "supervised" by one of their number, not out of distrust of the archaeologists but rather to protect the diggers from doing something that could bring practical or ritual danger: the totemic geography of a region contains some "dangerous places," into which archaeologists might stray through ignorance.

The Aborigines emphasized that permission to excavate would depend on their perception of the degree of responsibility and decorum with which the work was carried out. The team planned to limit the extent of its excavations (to extract a maximum of information with a minimum of digging), and, after completion, to refill the pits and return the sites to their original condition. The Aborigines also stipulated that work at one



Kakadu National Park is rich in Aboriginal rock art. This figure comes from the Anbangbang site.



The location and boundaries of Kakadu National Park in Australia's Northern Territory, with the sites studied.

site must be finished before proceeding to another – an admirable dictum for all archaeology!

In order to streamline the work, the excavations were to be integrated not only with the sieving and processing of material but also with preliminary analysis in a field laboratory. Geomorphological work was carried out on the excavated deposits while they were still open. A portable computer was taken into the field, so that data from the worksheets could be entered quickly onto floppy disks. In this way, preliminary analyses could be carried out while still excavation was still continuing, enabling the team to use the results as a guide for formulating the questions about the next phase of excavation and so on. Senior Aboriginine men representing the relevant groups accompanied the team on field trips and carefully monitored the excavations, while trainee Aboriginal rangers helped in the laboratory, and were instructed in archaeological procedures.

The Choice of Area and Sites

An area was selected about 60 km (37.5 miles) south of previous foci of investigation, so as to build up a regional pattern of site use. In order to take in a variety of environments, the team chose a transect running NW/SE, from huge open sites on the floodplains and freshwater swamplands of the South Alligator river to the large caves and rockshelters on the edge of a massif, and, finally, to the rockshelters in the inland valley of Deaf Adder Gorge, within the Arnhem Land escarpment. It was hoped that such a transect would provide information on seasonal differences of land use, and also help to contrast freshwater systems with the estuarine areas previously studied to the north.

The project carried out excavations and/or surface collections of artifacts in seven rockshelters. Two of these proved to be of major importance: Anbangbang I for its wealth of preserved organic material, and the Lindner site for its stratified sequence of over 2.5 m (8.2 ft) of sands resting on artifact-bearing rubble that probably dates back 60,000 years according to Optical Dating. A total of 30 radiocarbon determinations have been obtained, two-thirds from archaeological sites and the other third from geomorphological locations designed to resolve archaeological problems: they span a period from 12,000 years ago to modern times.

Anbangbang I Rockshelter

Anbangbang I is a huge rockshelter that seemed suitable for investigation because the material on its ground surface suggested a rich and varied record. It was hoped that this might give a detailed picture of economic activities during the immediate precolonial period, which could in turn be linked with ethnographic information from written sources and from contemporary Aborigines of the area. Another factor was its ease of access from early in the dry season.

Dating and Preservation. It was found that humans started occupying the site considerably before 6000 years ago, and probably in the late Pleistocene (i.e. before 10,000 years ago), judging by the depth and geomorphology of the artifact-bearing gravels. The intensity of occupation (the density of tools and organic remains) increased markedly about 6000 years ago, and then again about 1000 years ago.

The preservation of organic material is remarkable in the site's upper level. Usually, stone tools are the only things to survive in most sandstone rockshelters in tropical Australia – sandy soil conditions generally provide a poor environment for the preservation of any-

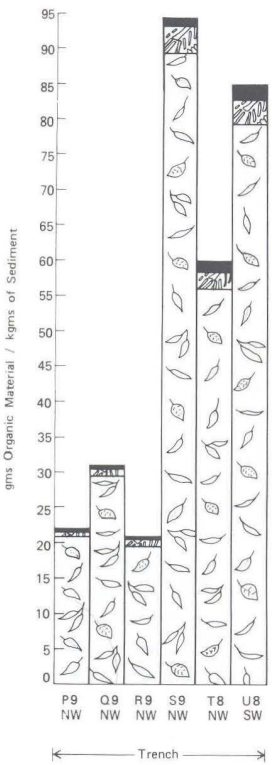
thing else. The dry microenvironment at Anbangbang, however, has permitted good preservation, especially at the sheltered rear of the site.

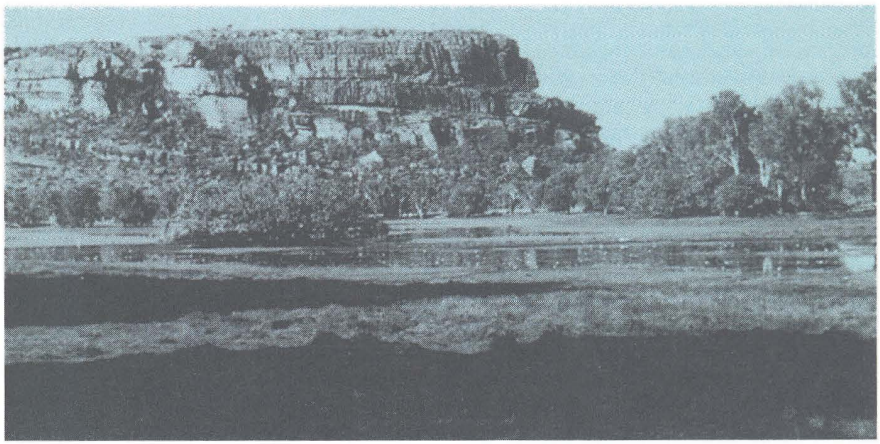
Technology, Diet, and the Division of Labor. Thanks to the good preservation the team was able to assess the relative role of stone as opposed to wood and other organic implements within a "total" toolkit over the last millennium. Stone tools were clearly of less importance than they appear to be in most sites where only inorganic tools survive. There were numerous bone implements (notably large awls), and some had traces of gum resin indicating that they had been barbs, probably hafted onto fishing spears. Almost 40 wooden tools were also recovered, including barbed spearpoints for hunting large game or for fighting.

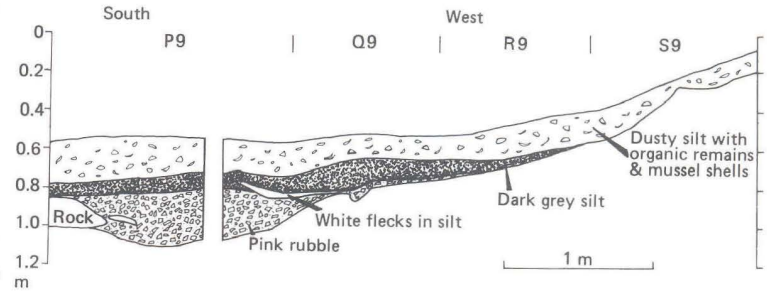
Numerous slivers and shavings of wood indicated that the manufacture and maintenance of spears were carried out at the rockshelter (by the men, according to ethnography), while women were probably responsible for weaving the string (found in some quantity) from fibers and hair.

Fragments of reeds and bamboo represent the shafts of weapons, and most probably came from the wetlands, at least a day's walk away, perhaps through some system of seasonal trade. Remains of plant resources were so numerous (some of them were retrieved by flotation) that only a sample could be analyzed. Those present through human agency (deduced in part from ethnographic information) had been gathered from the nearby Anbangbang lagoon, no doubt by the women: water-lilies seem to have been exploited intensively, together with tubers and tree-fruits. Women probably also foraged the freshwater turtles, mussels, and crocodile eggs whose remains were recovered. The men, on the other hand, will have foraged the many large fish, as well as the larger animals: over 50 species were hunted. This was, therefore, a broad-spectrum economy.

Not all animals were represented by bones: for example, the echidna's presence was shown only by its quills and feces, suggesting animal intrusion rather than human agency. Proof of human exploitation – as in the case of the large marsupials such as kangaroo







Anbangbang I rockshelter. (Top right) The general area near the site, showing the southwest face of Burrung-gui Cliff, with the Anbangbang lagoon in the foreground. (Left) The relative proportional weight of plant remains, bone, and shell from different trenches excavated at the site. (Above right) Cross-section across trenches P9–S9, showing the stratigraphy.

A sample of the numerous plant remains at Anbangbang I being washed after flotation (Rhys Jones center of picture).

and wallaby – lies in the broken and burnt bones, and in marks of butchering and percussion. The minimum numbers of each mammal species were calculated on the basis of jawbones: the little red flying-fox and the short-nosed bandicoot were most abundant, but the large marsupials provided most meat.

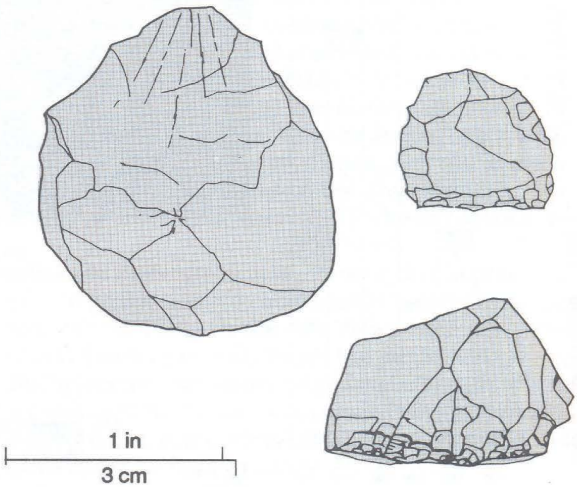
Both plant and animal remains point to a human presence (during the site's final phase, over the last millennium) in the wet season and the early dry season. The site was probably a base camp for a community of men and women, such as a band of perhaps 25 people, who carried out a wide range of domestic activities here. Anbangbang is one of the richest sites in the whole continent.

Lindner Rockshelter

Technology and Art. The Lindner site (Nauwalabila I) is a rockshelter situated within a plateau valley. The meter square excavated to a depth of over 2.5 m (8.2 ft) yielded more than 30,000 stone artifacts – an average of 12,000 per cubic meter, though they were denser at the top of the stratigraphy than below. Only about 1 percent of the material was retouched, showing that quartz and chert tools were fashioned and trimmed on site. In the lower layers, quartzite tools seem to have been brought in ready-made, whereas in the upper layers the final manufacturing of stone spearpoints was carried out here, with most of the finished products being taken elsewhere. The introduction of these spearpoints occurred between 6200 and 5700 years ago, whereas that of adze/chisels has been dated here to around 3500 years ago. Before these tool types appeared, there were hand-held scrapers and edge-ground axes: flakes from the latter were found down to levels dating to at least 14,000 years ago, which confirm the earlier findings in the region by Carmel Schrire (see above).

No bone material survived, apart from a few small burnt fragments from large mammals. However, one important find was the presence of coloring materials (pieces of red ocher with facets and traces of grinding) throughout the layers, down to a depth of 2.37 m (7 ft 9 in), dated to about 53,000 years ago by Optical Dating of unburnt sediments (see p. 153). Although they may have been used simply for body-painting, they do at least prove some artistic activity in the late Pleistocene, and it is quite probable that these "crayons" were used to prepare pigment for rock art, thus supporting the hypotheses of George Chaloupka about the antiquity of some of the region's depictions.

Thanks to flotation techniques, a sequence of about 200 charcoal samples was retrieved from the stratigraphy, and are now promising a detailed basis for calculating the (apparently steady) rate of accumulation of the deposit, and hence an accurate date for the lowest occupied layers. The Lindner site appears to be one of the oldest habitations in Australia.



Lindner rockshelter: steep edge scrapers from the lower layers of the site, which yielded more than 30,000 stone artifacts from a meter square excavated to a depth of over 2.5 m (8 ft). Clockwise from top left: quartz, red chert, and pink chert.

The Wetland-Edge Sites

The wetland edges proved to have a series of large, open sites (up to 25,000 sq. m or 269,000 sq. ft in area) mostly on headlands of dry land that were strategically located close to the rich food resources of the swamps. These sites seemed to consist mostly of surface scatters of thousands of artifacts, though one site (Ki'na) consisted of a shallow midden of freshwater mussel shells. The research team sampled each site's scatter by using a line of 1 m squares, 10 m (*c.* 33ft) apart, along its major axis, thus providing some idea of variation in the density of material, and within-site patterning of different elements. In addition, on each site at least one area, 5 m (just over 16ft) square, was laid out and subdivided into 25 × 1 m squares, from which separate, total collections of surface archaeological material were made, to obtain extra information on configurations of material. The 5-m squares were located arbitrarily, after initial survey, in areas of least disturbance or which seemed to provide as large and varied a sample as possible.

Among the millions of stone flakes and other artifacts – which, it must be remembered, were all carried into the sites by the occupants as there is no stone in the wetlands – there were many of quartz from nearby sources, whereas quartzite had been brought from a distance of 20–40 km (12–25 miles), and chert from over 50 km (31 miles). There were also grinding stones of sandstone and volcanic rock (brought from outcrops a few kilometers away, no doubt for the processing of plant foods), and adze/chisel slugs. Under strong magnification, it was found that some of the slugs had a narrow band of high polish, just a few micrometers wide, together with striations at right angles to the edge, which fit the criteria for wear caused by working hardwoods.

In many wetland sites (but not the inland sites), flakes were found, often unretouched, with a thick silica polish on them, probably caused by plant phytoliths when cutting grasses or reeds. The Japanese researcher Hiroshi Fujiwara processed soil samples from the Ki'na freshwater swamp, and also from archaeological sites (both wetland open sites and from rockshelter excavations) and found phytoliths primarily from wild rice (*Oryza*), as well as from grasses and reeds. The fact that no rice phytoliths were found at Anbangbang suggests that this plant was unavailable at the nearby lagoon.

It is clear, therefore, that in the recent past the wetland edges were densely occupied, most probably specifically in the dry season to take advantage of the wetland resources (especially plants and water birds). The base of the Ki'na midden was dated to 500 years ago, and it is reckoned that all these sites are of similar age (ranging between 1000 and 500 years). The reason for the increase in settlement at this particular time was established by paleoenvironmental work, to which we now turn.

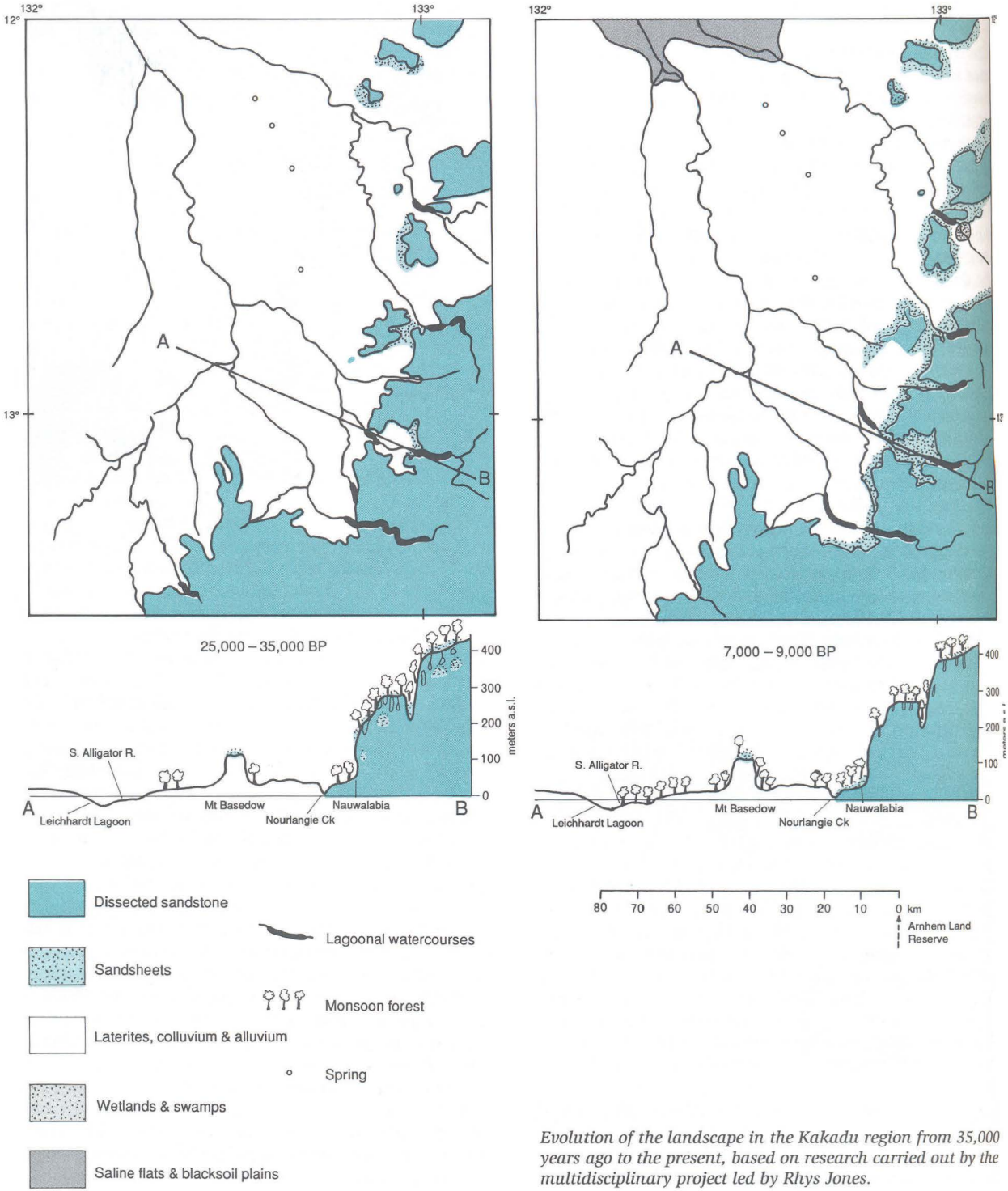
The Broader Picture: Changes in Environment and Economy

A section of the team studied the past and present landscape around the archaeological sites, attempting to assess how and why it has changed, especially over the last 35,000 years. Soil samples were removed for sedimentary and pollen analysis as well as for radiocarbon dating of organic materials. One of the most crucial dates was that of about 1400 years ago for the base of the freshwater peats, showing that the creation of the freshwater swamps is a fairly recent event.

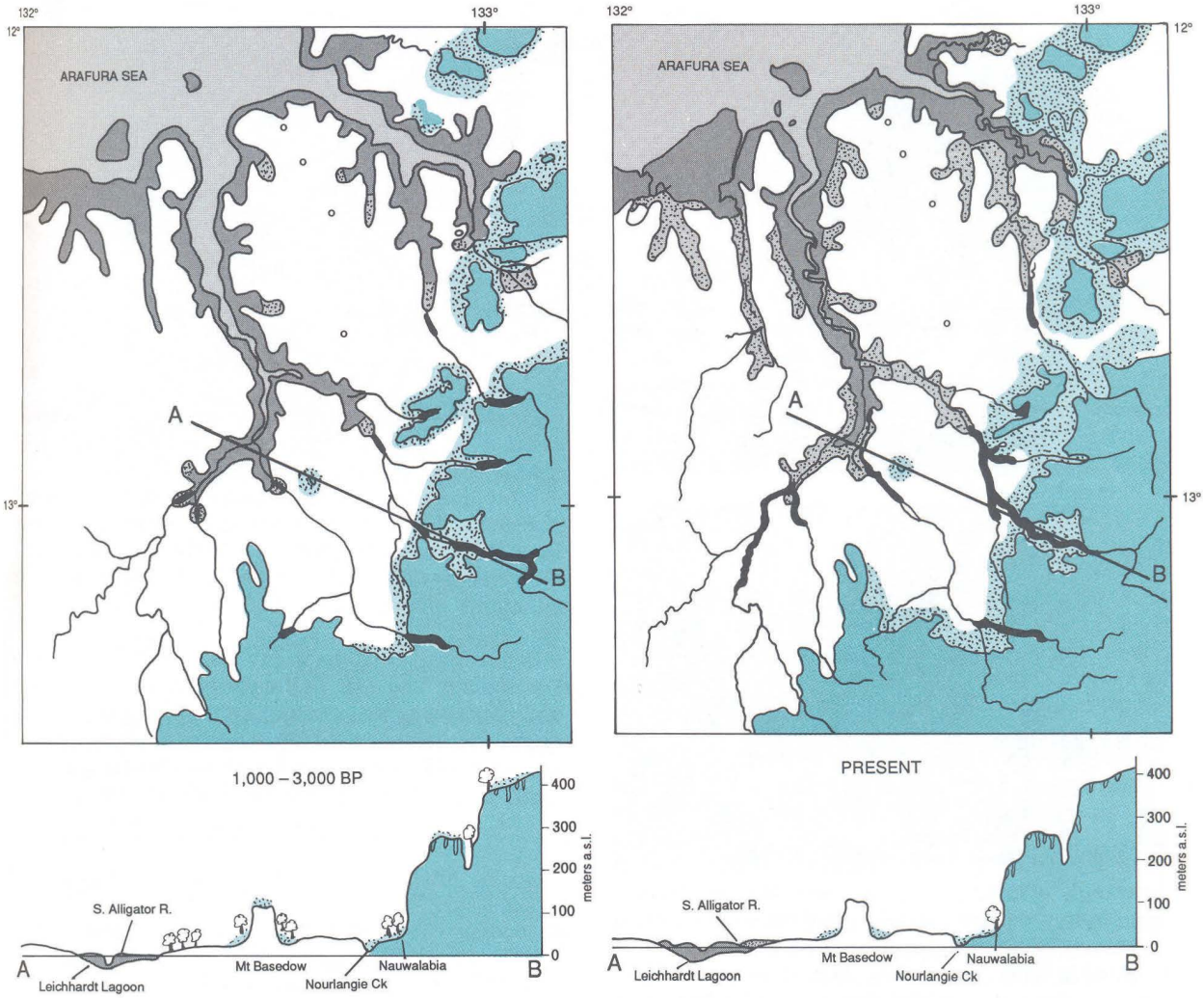
It was established that the most substantial change came when the postglacial rise in sea-level flooded the Alligator river valleys; these estuarine conditions existed by 6000 or 7000 years ago, a fact that fits well with the worldwide sea-level curve. Saltwater extended well up the valleys, and large areas of saline plains and mudflats evolved. Subsequently, there was a period of infilling of the river valleys, with silt and sand deposits building up into levees; freshwater was ponded up behind them, and eventually within the last 2000 years created the rich and productive freshwater wetlands that were seasonally flooded. It will be recalled (see Chapter 6) that George Chaloupka's theories link the styles of rock art in the region to these same transformations of the landscape. No evidence was found by the project team for great change in the inland vegetation over this period.

The sparse early archaeological material suggests that, before the formation of the freshwater swamps, population density was low, with occupation perhaps sporadic or seasonal. The arrival of the sea around 6000 years ago seems (from the evidence discovered at Anbangbang) to have led to denser occupation; but clearly it was the creation of freshwater swamps about 1000 years ago that transformed the landscape, dramatically increasing the population density and leading the local Aborigines to alter their economy in order to take full advantage of the newly available food resources.

Large groups of people camped at the swamp edges, probably in the dry season, and carried out many maintenance and production activities there. The same groups may have occupied the inland shelters during the dry season; here the effects of the changed land-



Evolution of the landscape in the Kakadu region from 35,000 years ago to the present, based on research carried out by the multidisciplinary project led by Rhys Jones.



scape are less marked, but still detectable in the archaeological remains.

In addition, the sediments in the shelters provide some clues to the long-term human use of the landscape. Studies suggest that the sediments accumulated largely as a result of human activity in the vicinity. For example, the practice of regular burning caused soil erosion, which built up the sediments. The gradual erosion of the sandstone shelters themselves also contributed to the deposits. Changes in the rate of accumulation thus helped the team to judge how intensely people used the sites and the landscape, and corresponded well with the results obtained from other types of evidence.

Conclusion

The Kakadu project was thus very successful in producing a new and detailed picture of environment, subsistence, population, and technology in this important region of Australia for the past 60 millennia. In particular, it proved that there had been a significant increase in the number of sites, in population density, and in the intensity of site-use that can be closely correlated with the transformation of the landscape and its productivity.

Publication of the work followed swiftly: an interim report was produced by March 1983, and a monograph in 1985.

KHOK PHANOM DI: THE ORIGINS OF RICE FARMING IN SOUTHEAST ASIA

Aims of the Project

In 1984–85, the New Zealand archaeologist Charles Higham and Thai archaeologist Rachanie Thosarat excavated a large mound, 12 m (39 ft) high and covering 5 ha (12 acres), situated on a flat plain 22 km (14 miles) from the coast of the Gulf of Siam in central Thailand. The site lies an hour's drive east from modern Bangkok. Its name, Khok Phanom Di, means "good mound," and it is visible for miles around. The rice-growing lowlands here form part of one of the world's richest agricultural ecosystems, but very little was known of their archaeology. So a major aim of the project was to investigate the origins and development of an agricultural system on which a large proportion of humanity depends.

The Searchers

Areas of northeast Thailand had been quite extensively studied in the early 1970s, yielding such major sites as Ban Chiang and Non Nok Tha, the excavation of which by Chester Gorman and others provided evidence for a local tradition of bronze-working dating from about 1500 BC. Central and coastal Thailand, on the other hand, had seen little systematic archaeological work until the onset of the Khok Phanom Di project. The site was discovered by Thai archaeologists in the late 1970s and they took samples in 1978 and dug test squares in 1979 and 1982. The Thai excavator, Damrongkiadt Noksakul, obtained a radiocarbon date for human bone from the oldest burial he had found of 4800 BC. If the new excavation could discover evidence of rice cultivation here at this early date, it would begin to rival the earliest dates for domesticated rice known from China.

What Is Left?

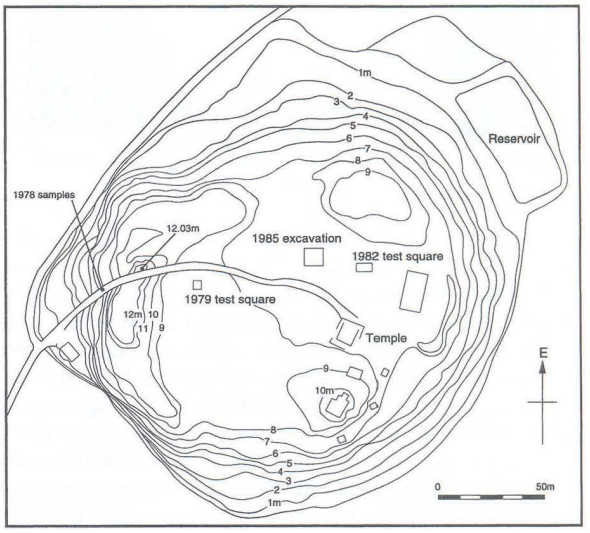
Preservation of some materials was outstanding at the site: some postholes still contained their original wood in place, and the layers were rich in organic remains such as leaves, nuts, rice-husk fragments, and fish scales. No fewer than 154 human burials came to light, with bones and shell ornaments intact – one of the largest and certainly the best provenienced collections of human remains from Southeast Asia. Some graves yielded sheets of a white fabric which proved to be shrouds of unwoven fabric – some of beaten bark, others sheets of asbestos, the earliest such use known use of this material which occurs naturally in Thailand, and which was highly valued in the ancient world as it was virtually indestructible and fire-resistant. Bodies lay on wooden biers.

Where?

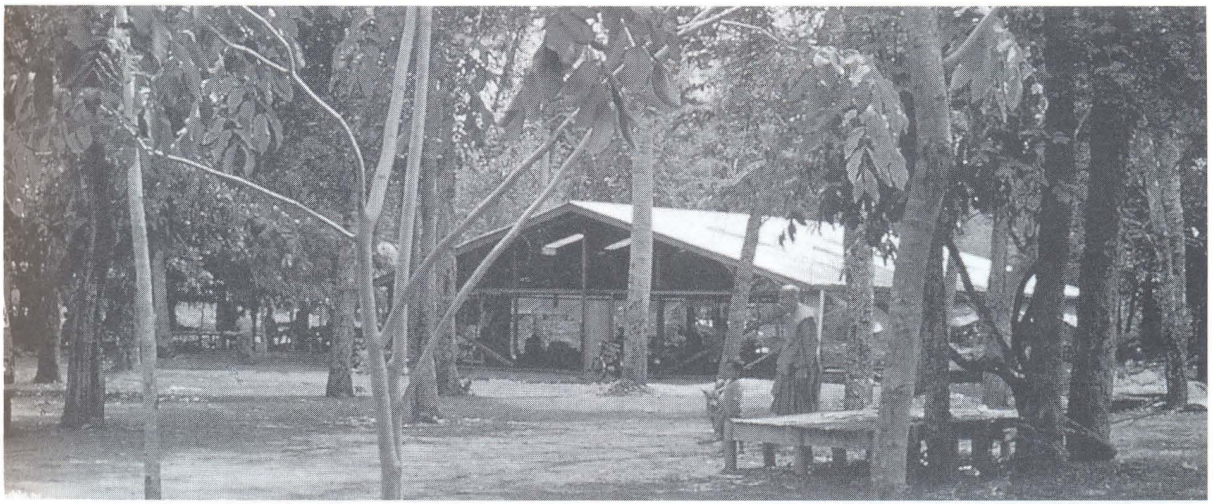
A 10 × 10 m (33 × 33 ft) square – large enough to give adequate information on the spatial dimension at the site – was dug in the central part of the mound, a spot chosen by the Abbot of the local Buddhist temple because it would avoid damaging any of his trees. A roof was built over the square to permit work even in the rainy season, and brick walls were required to prevent water filling the excavation.

After more than seven months of hard and continuous work the excavation came to an end when the natural mud flat layer was finally encountered at the considerable depth of 7 m (23 ft). Many years of laboratory analysis of the tons of excavated material lay ahead.

Before beginning the excavation of Khok Phanom Di, Higham, Thosarat, and three other colleagues had spent six weeks undertaking a site survey in this part of the Bang Pakong Valley. They walked the survey area 20 m (65 ft) apart, studied aerial photographs, and interviewed local villagers and Buddhist priests. The



Plan of the almost circular mound of Khok Phanom Di, Thailand, which covers about 5 ha (12 acres). It rises to a maximum of just over 12 m (39 ft) above the flood plain.



The searchers at Khok Phanom Di. In 1984–85 excavations were undertaken by New Zealand and Thai archaeologists, led by Charles Higham and Rachanie Thosarat. (Above) The roof covers the excavation; the site was chosen by the local Buddhist Abbot. (Right) The excavators encountered an extraordinarily deep and detailed stratigraphic sequence.

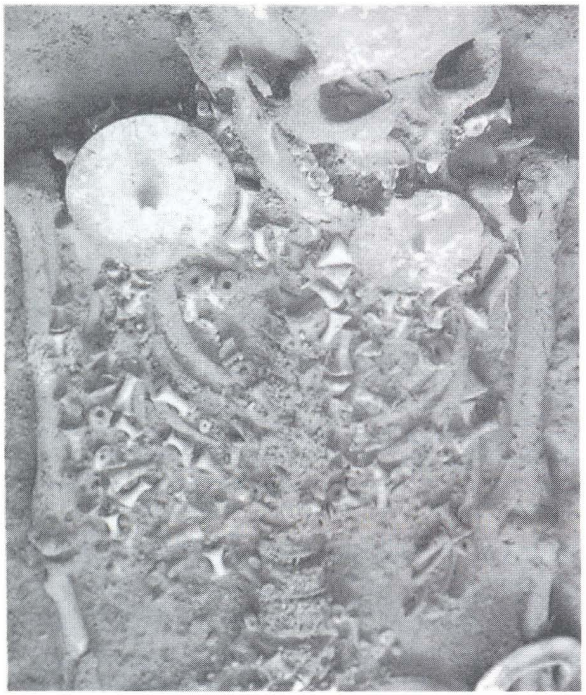
survey showed, if nothing else, that Khok Phanom Di was not an isolated site, but one of several early villages in the area. In 1991 Higham and Thosarat returned to the valley to begin the excavation of one of these sites: Nong Nor (see pp. 521–22).

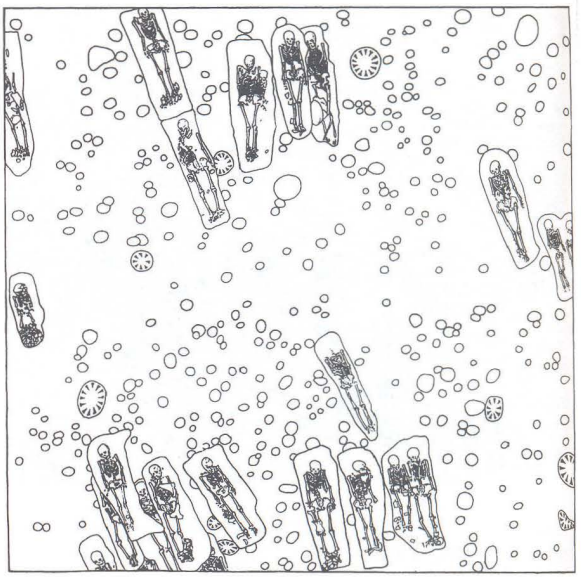
When?

It had been assumed, from impressions gained in the field and the dates obtained by earlier excavators from human bone, that Khok Phanom Di had first been settled in the 5th millennium BC. Its numerous hearths provided charcoal samples for radiocarbon dating. First results from six samples studied at a laboratory in Wellington, New Zealand, gave one early date, but the series did not form a coherent pattern. Then the Australian National University laboratory produced an internally consistent series of dates based on 12 samples. Interestingly, however, these ANU results revealed that the site was occupied for a far shorter time than had been thought – a few centuries rather than millennia. Higham and Thosarat concluded that the settlement had been occupied from about 2000 BC for 500 years (after calibration of the dates). Although this was disappointing in some ways (in terms of finding early dates for rice cultivation), it nevertheless meant that the 154 burials from the site might well represent an unbroken mortuary tradition – a rare occurrence at any site, anywhere in the world. This resulted from the very rapid accumulation of cultural remains which, in effect, kept pace with the successive superimposed interments.

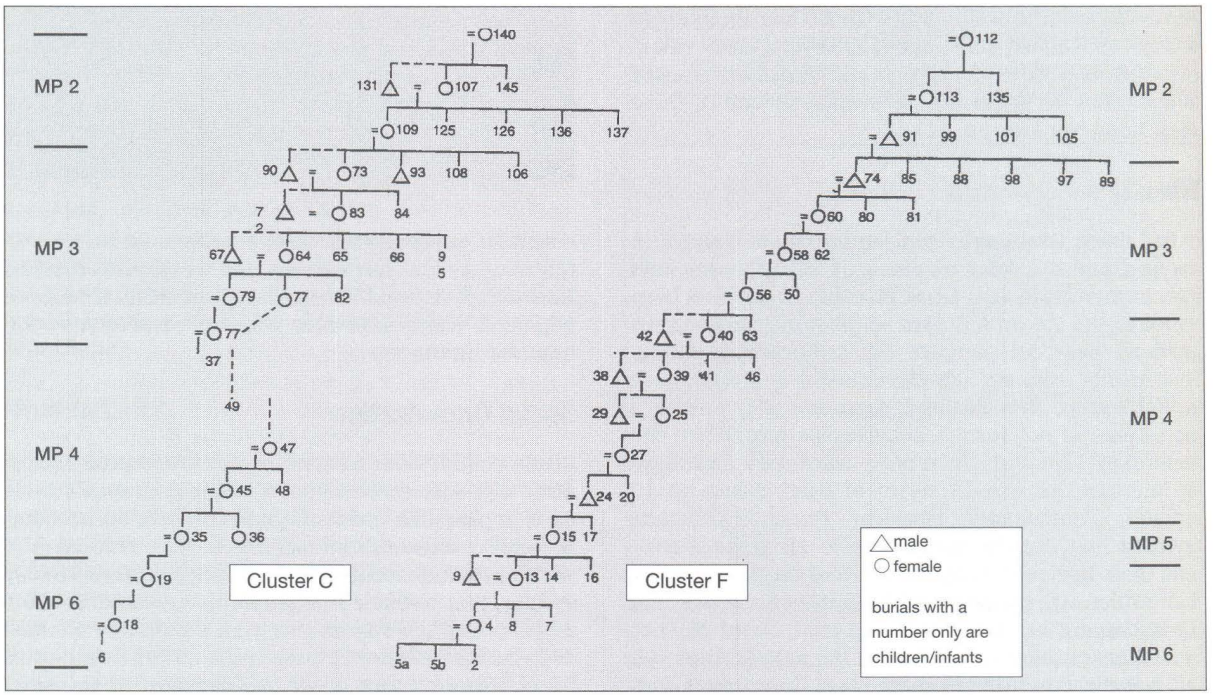
Social Organization

It was quickly noticed that the graves occurred in clusters, with spaces between. Computer graphics were used to plot their concentrations in three dimensions. A very detailed burial sequence was worked out, which provided insights into the community's kinship system over about 20 generations. (Assuming about 20 years per generation, this gave a timespan of about 400 years, satisfactorily close to the 500 years allocated by radiocarbon dating for the duration of the site.) Variations in the presence and quantity of grave-goods – shell jewelry, pottery vessels, clay anvils, and





(Left) The "Princess," who was accompanied by a set of shell jewelry, with over 120,000 beads, a headdress, and a bracelet, as well as fine pottery vessels. (Above) In Mortuary Phase 4 the dead were buried individually, in neat rows.



Two prehistoric family trees. Analysis of the skeletal remains from mortuary phases 2 to 6 allowed the archaeologists to suggest two genealogical sequences, C and F. Tracing families down the generations like this is extremely rare in prehistory.

burnishing stones – were analyzed with multivariate statistics, namely cluster analysis (see box, p. 197), principal component analysis, and multidimensional scaling (see box, pp. 206–07). It was found that there was no significant difference in overall wealth between males and females, though in the later phases they displayed variations: clay anvils were found only with females and the young, while turtle-shell ornaments were found only with males. Also in these later phases, there was a predominance of women, some of them buried with considerable wealth – one, nicknamed the "Princess," had over 120,000 shell beads, as well as other objects, a profusion and richness never before encountered in prehistoric Southeast Asia. But the descendants of the "Princess" were buried with very few grave-goods: this was not a society in which social ranking was inherited.

Nevertheless there was a clear link between the wealth of children and the adults with whom they were buried – poor children accompanied poor adults, or both categories were rich; a person's age does not seem to have been a determining factor in the quantity of grave-goods. Infants who failed to survive beyond birth were buried in their own graves or with an adult, though without grave-goods; but those who survived a few months before dying were given the same funerary treatment as adults.

Analysis by the physical anthropologist Nancy Tayles of the human remains (see pp. 520–21) suggested that two main clusters of burials represented successive generations of two distinct family groups. A number of genetically determined hereditary features in skulls, teeth, and bones enabled relationships between some individuals to be established, and these links confirmed that the individual's comprising each cluster were related. Patterns of tooth extraction were found in both sexes: the commonest was the removal of both upper first incisors in men and women, but only women had all the lower incisors removed as well. The consistency of some patterns was compatible with their being markers for successive members of the same family line.

Environment

The site is surrounded by flat rice fields, and is now 22 km (14 miles) east of the sea. However, it used to be located at the mouth of an estuary, on an ancient shoreline formed when the sea was higher than its present level, between 4000 and 1800 BC. This was deduced from radiocarbon dating of charcoal in cores taken by the paleoecologist Bernard Maloney from sediments in the Bang Pakong Valley, 200 m (650 ft) north of the site. These cores, which document human and natural environments back to the 6th millennium BC, also contained pollen grains, fern spores, and leaf fragments; there were several periods – 5300, 5000, and 4300 BC – showing peaks of charcoal, fern spores, and the pollen of weeds associated today with rice-field cultivation. Although rice cannot be identified directly from pollen, the decline in tree species, rise in burning, and increase in rice-field weeds could reflect agriculture in this area in the 5th millennium BC. Subsequent analysis of the plant phytoliths (see p. 242) from the cores confirmed at least part of this hypothesis. Phytoliths of rice (whether wild or domesticated cannot yet be determined) were discovered together with those of agricultural field weeds at the 5th-millennium BC level – although they disappear shortly after, not to return until about 3000 BC, approximately 1000 years before the first occupation of Khok Phanom Di. The phytoliths however, suggested that the earliest episodes of burning are more likely associated with fuel production than agricultural activity. Thus, while the burning could have been associated with agriculture, burn-offs by hunter-gatherers, or even normal conflagrations might have been involved as well.

The deposits in the excavated square were found to contain ostracodes and forams, minute aquatic creatures with restricted habitats. Their frequencies in successive layers demonstrated that the site used to be on, or near, an estuary, with freshwater marshes behind it. Eventually, however, the sea retreated, and brackish water came to dominate, but with freshwater ponds still nearby.

Organic remains from the excavation were collected by the paleobotanist Jill Thompson using flotation – which yielded charred seeds, fragments of rice, and tiny snails. Some potsherds near the bottom of the site were encrusted with barnacles, indicating that the site had once been low-lying and overrun by seawater during tidal surges. Thousands of fragments of bone were recovered from mammals, fish, birds, and turtles, as well as the remains of crabs and shellfish. Their analysis revealed the presence of crocodile and open-coast birds such as cormorants in early contexts, but marshland and mangrove birds like pelicans and herons in later phases. Finally, marine and riverine species were replaced by birds of woodland and forest, such as crows and broadbills, together with porcupines and bandicoots, animals that prefer dry conditions. Similarly, the fish remains show a predominance of estuarine species in the early phases, but later freshwater fish took over; and the molluscs showed a change from sandy-coast and marine species to mangrove, estuarine, freshwater, and ultimately land species.

It was therefore clear that the site was originally located on a slight elevation by an estuary, near an open coast with some clear sandy areas. The sea gradually retreated as sedimentation increased the site's distance from the shore. Eventually the river itself moved away to the west: this change to a non-estuarine habitat may have involved the formation of an oxbow lake, preventing ready access to the river, or even a major flood which moved the river away from the site.

Diet

The site yielded well over a million shellfish, as well as animal bones and seeds. Since the shells could not all be transported to a laboratory, the commonest species, a cockle, was counted in the field and 10 percent of its shells were kept. This cockle, *Anadara granosa*, is adapted to mudflats and found in estuarine locations. A mere eight species comprised 99.4 percent of the shellfish, all of them sources of food.

However, it appears from food residues and other evidence that fish and rice were the staple diet here, as they are today. In the grave of one woman, who died in her mid-40s, a mass of tiny bones was found in her pelvic area – not a fetus, as first thought, but the remains of her last meal: bones and scales from *Anabas testudineus*, the climbing perch, a small freshwater fish. Tiny pieces of rice chaff were found among the scales, together with stingray teeth. Another grave contained human feces which, under the microscope, revealed many fragments of rice husk whose morphology indicated that the rice was domesticated. Among the husks was a beetle, *Oryzaphilus surinamensis*, which is often found in stored products such as rice, and hair from mice, which may also have haunted the site's rice stores. Finally, some pottery vessels had been tempered with rice chaff before firing; some potsherds had a thin layer of clay on the outside, containing a dense concentration of rice husk fragments; and fragments of rice were recovered from the archaeological deposits.

Clay net-weights provided further evidence for fishing, as did bone fishhooks which became increasingly rare with time. Few large animals were represented – mostly macaques and pigs – showing that they were of little importance as food; it is not clear whether the pigs were domestic or wild. No domestic animal apart from the dog has been positively identified.

Technology

Khok Phanom Di was a center for pottery-making throughout its occupation, being located in an area rich in clay deposits. Thick spreads of ash indicated where people had probably fired their pots, and some graves contained clay anvils, clay cylinders, and burnishing pebbles, implements used in the shaping and decoration of pots. The techniques of pot decoration remained virtually unchanged throughout the centuries of the site's occupation, but new forms and motifs were introduced. The site produced tons of pottery, about 250,000 shell beads, and thousands of other artifacts – many as grave-goods, but others discarded when broken or lost.

Some shells had been modified and apparently used as tools. There were striations and polished areas on their concave surfaces. Experiments with similar shells showed that some of these marks were formed by abrading them with sandstone from the site to sharpen their cutting edge. A series of possible uses were tried out – cutting wild grasses, incising designs on pottery, cutting bark-cloth, and processing fish, taro (a tropical food plant), meat, and hair. The prehistoric and modern experimental specimens were then examined under the scanning electron microscope, and some tasks could be eliminated at once: the prehistoric shells had clearly not been used to decorate pottery, gut fish or cut bark-cloth. By far the most likely function was harvesting a grass such as rice, which not only produced the same pattern of striations and polish but also required frequent sharpening.

Although no remains of woven fabric have survived, the abundance of cord-marked pottery and the existence of fish nets (as shown by the presence of net-weights) indicate the use of twine and cordage. Small bone implements with a chisel-shaped end and a groove down one side have been tentatively interpreted as shuttles, used in weaving cloth.

What Contact Did They Have?

Thin sections taken from some of the site's stone adzes helped to pinpoint likely sources of materials; it was found that the stone quarries must have been in the uplands to the east, where outcrops of andesite and volcanic sand- and siltstones occur. One adze of calcareous sandstone must have come from 100 km (63 miles) to the northeast.

Since the site contains almost no stone flakes, it is probable that the occupants obtained ready-made stone adzeheads in exchange for their fine ceramics and shell ornaments.

What Were They Like?

In Southeast Asia it is unusual for soil conditions to allow the preservation of bone, but at Khok Phanom Di

the excavation encountered a "vertical cemetery," an accumulation through time of 154 inhumations. After conservation of the bones and two years of analysis by Nancy Tayles they could be aged and sexed, as far as was possible, and other indicators used – for example, pelvic scarring indicated whether a woman had given birth. In terms of health, it was found that the earliest occupants of the site had been relatively tall with good, strong bone development indicating a sound diet. Nevertheless, they had died in their 20s and 30s, and half had perished at birth or soon after. A thickening of their skulls suggested anemia, probably caused by the blood disorder thalassemia (which may paradoxically have provided some resistance to the malarial mosquito). The adults also suffered some dental disease, and considerable tooth wear owing to the number of shellfish consumed.

In this early group, the men – but not the women – suffered degeneration of the joints, especially on the right side, indicating regular and vigorous use of these limbs, probably from paddling canoes. Men and women also had different diets, as shown by their tooth wear and decay.

A subsequent phase features a notable fall in infant mortality, but men were smaller and less robust than before, with less degeneration of the joints, suggesting they were relatively inactive. They also had healthier teeth, no doubt caused by a different diet incorporating fewer shellfish

The human feces found in one burial contained an egg, probably from the intestinal fluke *Fasciolopsis buski*, which finds its way into the human digestive system through the eating of aquatic plants. However, there is no evidence whatsoever of violence or warfare; there are no injuries or traumas visible in the human bones.

Why Did Things Change?

All these varied categories of evidence form a fairly coherent picture. At first, the occupants had the river close by, and offshore colonies of shellfish suitable for the manufacture of jewelry. Despite high infant mortality and anemia, the men were active and robust, with particular strength on the right, probably caused by canoeing. Some people were buried with considerable wealth. The men were engaged in fishing and obtaining supplies of shell, while the women probably made pots in the dry season and worked in the rice fields during the wet.

It is known from ethnography that environments of this kind can expect a disastrous flood every 50 years or so, with not only inundation but also destruction of fields and the relocation of rivers. The excavators believe that this is what caused the changes in the environmental and archaeological record at Khok Phanom Di after about 10 generations: the large river burst its banks and relocated to the west. By this time, the sea was already some distance away, and silty water had eliminated many of the shellfish used for jewelry.

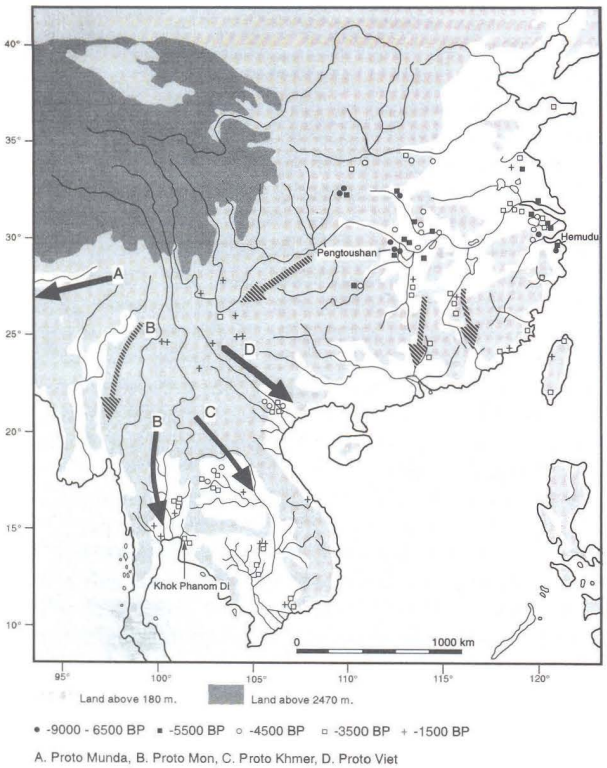
Following the change, hardly any shell beads are found with the dead, and pottery was less decorative. The men were less robust, less active; fishhooks and net-weights were no longer made, there were fewer marine and estuarine fish, less shellfish, and teeth show a less abrasive diet. This all suggests that once the flood had occurred, the site no longer had easy access to the coast, so men stopped going out to the estuary or sea in boats.

In the later phase, there was a dramatic rise in wealth, and burials were more elaborate, while pottery vessels became larger and display enormous skill. Women now predominated in the cemetery, and one of them had very well-developed wrist muscles. It has therefore been hypothesized, through ethnographic accounts from the islands of Melanesia, that the rise in wealth, prestige, and power came from exchange activities. There was a development of craft specialization, centered on the women; they made pottery masterpieces, which were traded for the shells that could no longer be obtained locally. Hence their skill was converted into status in the community. The women may have become entrepreneurs, with men in a subservient role; or conversely, the men may have exploited the women's skill to boost their own status, and placed their womenfolk in large graves, accompanied by a great wealth of rare and prestigious shell jewelry.

Conclusion

One of the principal original aims of the project had been to help elucidate the origins and rise of rice agriculture in Southeast Asia. Settlement at the site itself proved to be too late (2000 BC) to overturn the conventional view that rice cultivation began further north in China, in the Yangzi Valley, before 5000 BC and spread south from there. But pollen and phytolith analysis of cores from sediments around Khok Phanom Di provided elusive evidence for at least some agricultural activity involving wild or domesticated rice as early as the 5th millennium BC in this part of Thailand.

The more recent excavations conducted by the same team at Nong Nor, 14 km (9 miles) to the south, have helped clarify this situation. Nong Nor comprises in its first phase a coastal site dating to 2400 BC. Its pottery,



The spread of rice agriculture and languages in Southeast Asia.

bone, and stone industries are virtually identical with those from early Khok Phanom Di. But there is no rice, nor are there any shell harvesting knives or stone hoes. Higham and Thosarat suggest that this represents a coastal hunter-gatherer tradition, and that rice cultivation was introduced into Thailand between 2400 and 2000 BC, ultimately from the Yangzi Valley. In this interpretation, the early inhabitants of Khok Phanom Di would have either adopted the new resource, or perhaps themselves experimented with the plant.

The excavation and analysis of Khok Phanom Di have been exemplary for several reasons. To begin with, they demonstrate just how much information can be obtained from a single burial site with good preservation, using a truly multidisciplinary approach. The many years of analysis of the site's stratigraphy, the human bones, shellfish, charcoal samples, plant remains, and artifacts, have culminated in the publication of a wide range of reports, notably a full-scale four-volume research report (Higham and others 1990–93), with three more volumes planned, and a shorter synthesis by Higham and Thosarat (1994). Above all, the project has shown that well-focused research can both cast new light on an issue of wide general importance – the origins of Southeast Asian agriculture – and also greatly increase our understanding of the local archaeological record in a previously little researched region of the world.

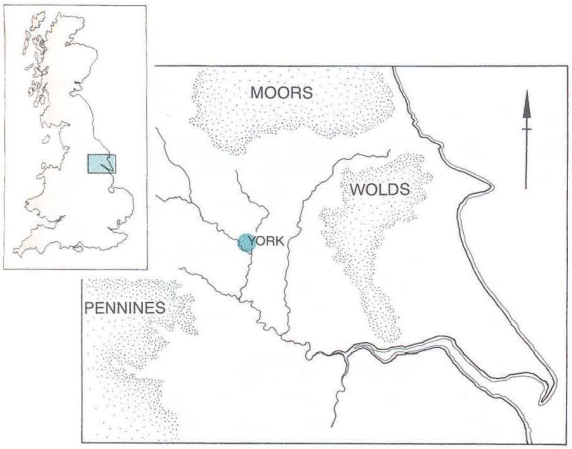
YORK AND THE PUBLIC PRESENTATION OF ARCHAEOLOGY

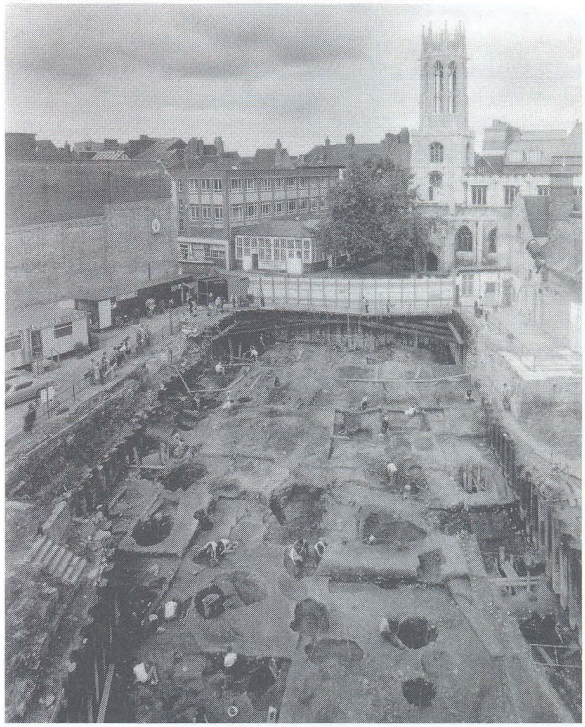
York is one of the great early cities of Europe, at times in its history it was the most important place in northern England and second in significance only to London; it is also the home of one of Britain's great cathedrals, York Minster. Successively the site of a Roman legionary headquarters, an Anglo-Saxon royal and monastic center, and a major Viking town, York retained its importance in Norman and medieval times and today offers a fine illustration of the complexity of archaeology in a continuously occupied city where the ancient and the modern are in close proximity.

We have chosen here to discuss the work of the York Archaeological Trust (YAT) in particular for two reasons. First, because the story of its origin and development provides a good example of the professional response to the conservation problems of urban archaeology, where the rescue issues are much the same as they would be in Peking, or Delhi, or downtown Manhattan (see pp. 216–17). And second, perhaps more importantly, because the Trust was a pioneer in techniques seeking actively to engage the interest of a much broader public, and has developed innovative and highly successful approaches to achieve this, most notably the Jorvik Viking Centre (see below).

Background and Aims

From as early as the 1820s the archaeology of York had been of interest to local antiquarians, notably the Yorkshire Philosophical Society. In 1960 the first major survey of York was carried out by the Royal Commission on the Historical Monuments of England (RCHME). This survey highlighted Roman York, but in the course of the 1960s further work by the Commission brought to light York's Anglian and Viking phases, and between 1966 and 1972 excavations by the RCHME under York Minster, which was in danger of collapse, produced a record of continuous occupation from AD 79 to 1080 – one of the most important sequences in Europe.





York is situated at the confluence of two rivers, the Ouse and the Foss. (Right) Excavations in progress at Coppergate, before the construction of the shopping complex and Jorvik Viking Centre on the same site.

It was proposals for an inner ring road in the late 1960s, however, which caused alarm bells to ring, coupled with the general awareness at that time of the destructiveness of urban development across Britain. The York Archaeological Trust was formed in 1972 from a consortium of interests and Peter Addyman became its first Director. Its aim was to save archaeological evidence before it was destroyed by development – what has been called "preservation by record" (see p. 550), and Addyman took the decision to excavate only those sites under threat.

Already in that year there were salvage excavations on a number of sites. For instance, beneath the Lloyds Bank building over 5 m (16½ ft) of minutely stratified organic-rich deposits were found, dating from the 9th to the 11th centuries (see illus. p. 526). These had been airtight from the time of their deposition, and a wide range of organic materials of kinds which do not normally survive were preserved due to the anaerobic conditions, such as textiles, leather and wooden objects, industrial waste and coprolites, and biological organisms. It became clear that widespread area excavations in the Pavement-Coppergate area of the city could be expected to reveal in unprecedented detail the layout of a Viking Age town, preserved from that period in Anglo-Saxon history, prior to the Norman Conquest of AD 1066, when Scandinavian invaders dominated the north of England.

In the early days there were difficulties with some developers, whose permission and cooperation was by no means guaranteed. Out of such problems, not least in York itself, came national legislation, "The Ancient Monuments and Archaeological Areas Act" of 1979, as a result of which central York was designated one of the nation's five Areas of Archaeological Importance. For the next decade excavations were undertaken with the ultimate backing of a four-and-a-half month mandatory period of access, and many such excavations were carried out. But in 1989, through complex circumstances at the site of the Queen's Hotel, it became evident that this provision was insufficient. Similar problems arose in the same year at the site of Shakespeare's Rose theater in London (see p. 550).

Then in 1990 Martin Carver of the University of York and the engineering firm Ove Arup & Partners were commissioned by English Heritage and the City of York to produce a report on the methods and aims of urban archaeology. The report featured a predictive map of York's deposits and a research program whereby sites can be either excavated if they have a research priority or preserved if they do not. Several ideas contained in the report, notably the concept of "evaluation," were incorporated into the document being prepared at this time by the British Government – Planning Policy Guidance paper 16, which brought forward a new philosophy towards archaeology and development. PPG 16 stresses that archaeology is an irreplaceable resource, and makes the presumption in favor of preservation when archaeological deposits are threatened by development; it also stipulates that necessary archaeological work will be carried out at the expense

of the developer. This brought about the legal and planning system within which salvage archaeology works in Britain today. From 1990 much of the work carried out by the Trust has been undertaken as paid contractor to developer clients, carrying out projects specified by the City Archaeologist for York.

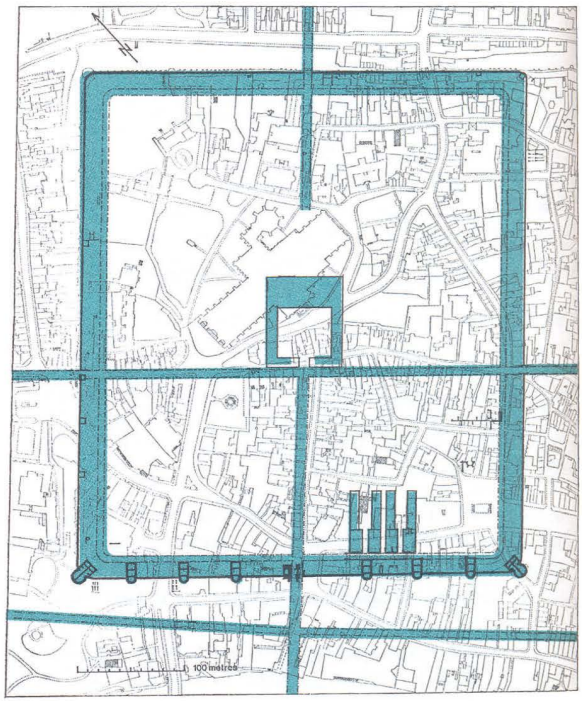
The objectives of YAT include "a broadly based examination of the whole process of urbanization over the past two millennia," and involve a pragmatic approach to the opportunities which minor works and major developments within the city may offer. Moreover there is a recognition that different classes of evidence must be brought to bear, for instance one objective of the Trust is to integrate the quantities of new archaeological data about medieval York with the evidence derived from place names, documentary sources, and standing buildings. However, one of the special and original aims of the Trust which evolved as a result of opportunities that arose during the course of work, was to present their findings in new and innovative ways to the public (see below).

Although here we are choosing to focus on the work of YAT, it was not, of course, carried out in isolation by the Trust alone. The excavations beneath York Minster by the RCHME – still the largest and most important to have taken place in York – have already been mentioned. A major urban project of this kind is always a cooperative work by a number of organizations, and in addition to the York Archaeological Trust and the Royal Commission, the Department of Archaeology at the University of York, the City of York Council, and the national organization English Heritage have all played major roles. The success of archaeology in York has depended upon such cooperation and indeed it provides an important lesson for urban archaeology everywhere.

Survey, Recording, and Conservation

On an urban site, a certain amount of potentially valuable information inevitably turns up in an uncontrolled way as a result of building activity. Such information can still be incorporated successfully into the whole picture. As Peter Addyman wrote in 1974:

> "Holes of one sort or another are always being dug throughout the city. In 1972 it has been calculated over 1500 were excavated by the Corporation alone. The Trust has therefore adopted the policy whereby chance finds are recorded systematically to help build up evidence for the extent, character, and intensity of settlement in the past."



The outline of the Roman legionary fortress at York superimposed on a plan of the modern city.

Skillful use of the available information can also suggest how next to proceed. For instance the indications of the plan of the Roman fortress revealed in the early stages of excavation, or already known, allowed a hypothetical plan to be drawn predicting where other traces would be found. The results of the urban survey of York were integrated into two maps produced in 1988 by the Ordnance Survey (the national British cartographic agency) in collaboration with the Trust and the RCHME. The first summarized what is known of Roman and Anglian York, and the second Viking and Medieval York.

As noted above, during the lifetime of YAT the climate of urban archaeology in Britain has changed, as Addyman recognized in 1992:

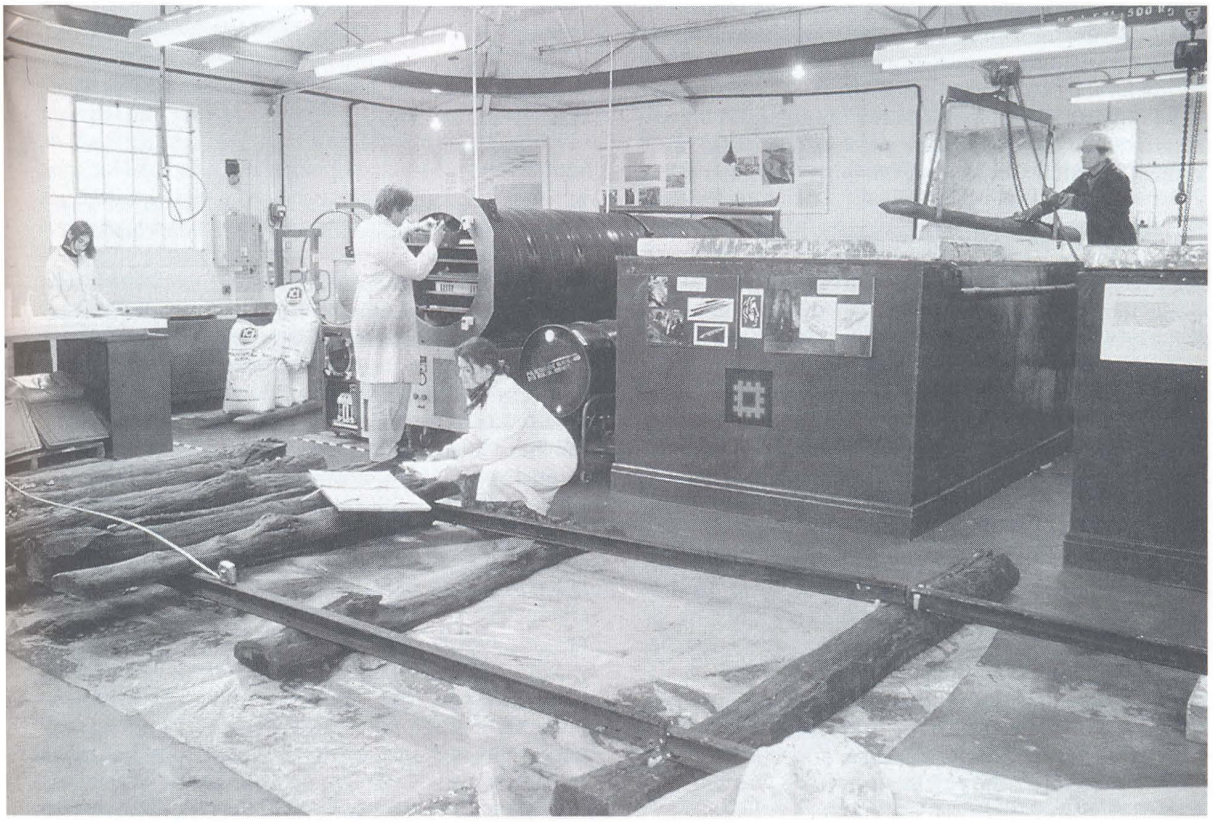
> "It seems possible that the era of large-scale excavation may be over. In a certain sense the Trust's first two decades may turn out to have been a golden age for York archaeology, for the large-scale excavations have transformed archaeological knowledge of the city. The 1990s, however, are a more responsible age, in which only a sustainable utilization of the archaeological resources is permitted. The new more selective approach to excavation will demand new

theoretical approaches. There will be emphasis on non-destructive evaluation by remote sensing; for example by radar; correlation of existing data through creation of sites and monuments records; predictive modeling by computer; and the use of GIS."

Such methods have been used at York, and the excavations from the outset began to develop a standardized system of recording, using a pre-printed "context card" for each stratigraphic unit. With the development of low-cost computers a Computer Integrated Finds Record system has been developed to cope with the vast quantities of artifacts, and an Integrated Archaeological Data Base to allow interrogation of the excavation and finds data generated in more than 25 years of continued excavation.

Recording systems have been developed and refined, and photogrammetry, based on measurement from stereoscopically projected pairs of photographs, has been used to produce the primary drawn record by the English Heritage photogrammetry unit, based in York. The definitive record of the Coppergate Anglian helmet (see below) was also achieved by photogrammetry and by holography. In some cases the simpler but useful technique of rectified photography has been used, even for site recording, as at the medieval cemetery at Jewbury. Here rectified vertical photography of each burial enabled the cemetery to be recorded at great speed. The human remains have now been reburied so the photographs form the only source of new information.

Conservation work has also been a major concern and a laboratory for waterlogged materials, including leather and wood, was established in 1981. Among other things, it has had to cope with structural features including 6-m (20-ft) long timbers from the Viking buildings in Coppergate. The Trust laboratory is now one of the main regional conservation centers: the York Archaeological Wood Centre opened at the laboratory in 1993, and is the national wetwood treatment center for English Heritage.



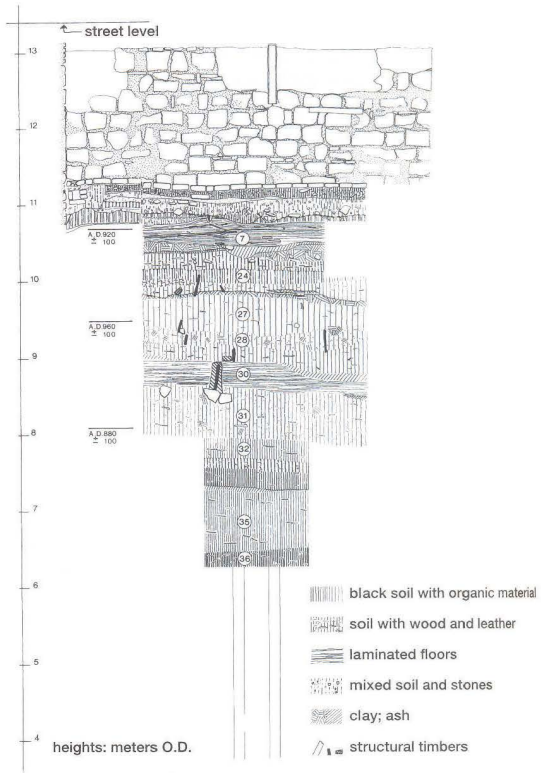
Excavations at York produced a large amount of wood and leather preserved due to the anaerobic conditions. The York Archaeological Trust's laboratory set up to conserve this material is now one of the main regional centers for this type of work.

Alongside this work, Julian Richards and Paul Miller of the Department of Archaeology, University of York, have developed a GIS for York. Data relating to deposits, monuments, as well as accidental finds can be stored in this way and used to create models of surfaces in York at a given period.

History and Dating

The broad historical outline of the Roman conquest, the Anglo-Saxon period, the Scandinavian ("Viking") invasions and the arrival of the Normans in AD 1067 are clearly established for York from historical sources (see below). But the detailed stratigraphic sequences, especially for the Anglo-Saxon and Viking periods, were able to bring a much better definition to the developmental sequence for the pottery and other artifacts.

A computer program is now used to reconcile the recorded relationships of the various site contexts and produce a comprehensive interpretive periodization. For instance, at the site for the new Lloyds Bank, on the street called Pavement, the stratigraphic sequence provided samples for radiocarbon dating, and these as well as coin finds permitted a precise chronological control for the pottery fabrics known as York Ware and Torksey Ware. A series of dendrochronological determinations for the Coppergate site has confirmed and further refined the ceramic chronology.



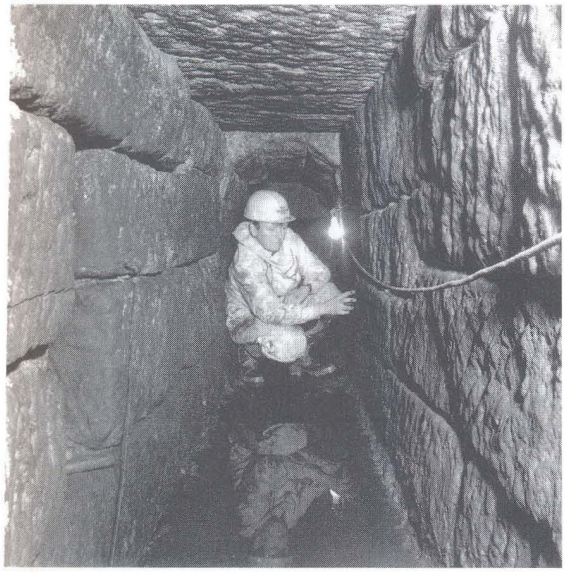
The stratigraphic section at the Lloyds Bank site on the street called Pavement provided the basis for a detailed chronology.

Phases of Urban Development

The study of deep stratigraphy on an urban site allows special insights into the development of urban life, particularly when there is abundant evidence also from written sources. For each of the main phases of occupation we know the name of the settlement from written texts (and often from locally issued coins). There is also the possibility, at least from the medieval period, of using charters, leases, and other documents relating to land tenure to relate to actual urban plots of land under excavation. Thus "Domesday Book," a national land survey conducted in the late 11th century AD, records two churches, All Saints and St. Crux, in the Coppergate and Pavement area of the City and a deed of AD 1176 relates to "land in Ousegate in the parish of St. Crux." The Shambles is also mentioned in Domesday Book, demonstrating that this street-line at least was already in existence before the Norman Conquest. Insights into successive urban phases have thus been gained, building up the picture of York's development:

Eburacum. Roman York. The legionary fortress and the adjoining Roman town (or *Colonia*) have been systematically investigated. The remains of the headquarters or *Principia* can be seen under York Minster. One remarkable discovery was the extensive system of stone-built sewers preserved beneath the city, from which organic remains produced valuable samples for study. Also informative was the study of remains thought to have come from warehouses, clearly representing the remains of a large quantity of spoiled grain (see pp. 250, 298). Evidence was also found of a basilica, barrack blocks, centurions' houses, and roads and alleys, making York one of the most fully known legionary headquarters in the Roman empire.

Eoforwic. Anglo-Saxon York. The collapse of the Roman empire at the end of the 4th century AD led to notable depopulation at York, and there are few remains from the succeeding two centuries. Historical records indicate that York was an important royal center in the 7th century and became the seat of an archbishop in AD 735. Not a great deal is yet known of the buildings of Anglian, or Anglo-Saxon York, but they must have contained an archbishop's church, an



Examination of one of the extensive system of Roman sewers still preserved beneath the city.

important monastic school, and almost certainly a royal palace (yet to be located). However, information on the Anglian settlement was found in YAT excavations at Fishergate, at the confluence of the rivers Ouse and Foss, which provides valuable insights into the economy of the period, showing that the site was already a center of trade with northern Europe. A splendid helmet of this period was recovered from Coppergate (see below). When the Vikings took York in AD 866 they would have found not a densely packed city, but a small town consisting of a series of smaller settlements each perhaps serving a different function, scattered around the area of the old Roman city and dominated by the walls of the Roman fortress. As the work in York has vividly shown, the city they created was a very different place.

Jorvik. Viking or Anglo-Scandinavian York. The excavations in the Coppergate area and beyond have given the clearest evidence yet available for a city of the Viking period in England. While the churches of the city were of stone, the houses and workshops were built of timber with thatched roofs. Their preserved remains formed the basis for the reconstruction undertaken at the Jorvik Viking Centre. Remains of the Roman walls would have been familiar to the inhabitants of Anglo-Scandinavian York: parts of the ruined Roman barracks were reused to house light industrial activities such as jet-working, and the *Principia* stub walls enclosed a wealthy cemetery. Within the old Roman city walls many of the parish churches and graveyards were established at this time.

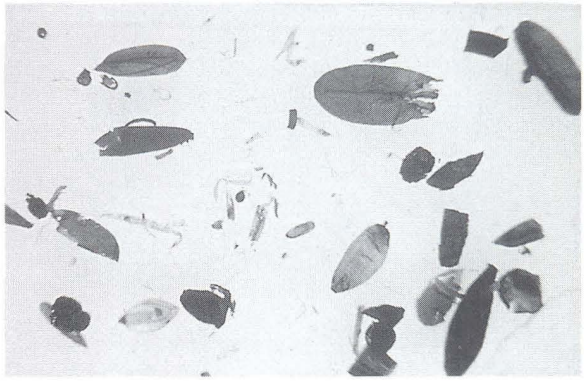
York. The medieval (and modern) city, from the arrival of the Norman invaders in AD 1067. Extensive excavations have clarified the plan of the medieval city, which until the early 15th century was to remain the second city of England, with a population of between 8000 and 15,000. Building of the Cathedral of St. Peter (York Minster) was begun on its present site in 1070, and fragments of stone houses of 12th-century date survive, along with many timber-framed houses from the 14th century and later. Other impressive remains of medieval York include city walls, traces of two castles, parish churches, and guild halls.

Environment

One of the most interesting features of the York excavations has been the study not only of general climatic issues and of the rural situation on the outskirts, but also of ecological conditions and activities within the town.

Excavations of Roman waterlogged occupation deposits at the Tanner Row site, close to the river Ouse, were highly informative. The plant, invertebrate, and vertebrate remains provided evidence for pre-occupation grazing land traversed by ditches, substantial "landfill" consisting largely of stable manure and other waste, and a range of imported foods. There were indications that the river was cleaner than in the medieval period or today (see p. 257).

The waterlogged levels beneath the fringes of the river Foss provided much interesting evidence relating to Viking Age York. The insect remains at 16–22



Plant and seed remains recovered by sieving. Excavations at York have provided a wealth of environmental evidence.

Coppergate, especially, permit one to reconstruct a whole series of small-scale urban environments, each the result of a specific human activity which created conditions of temperature and substrate suitable for specific insect communities. For example, there was a distinctive "house fauna," including human fleas and lice, typical of internal floors, while cess pits contained abundant flies and beetles indicating that foul matter had often been exposed for long periods, with consequent danger of infection. The distribution of lice gave indications that some buildings were domestic, others workshops.

The yards around and behind the buildings were pockmarked with pits, whose fills were mainly human feces rich in cereal bran and fruitstones (such as sloes and wild plums) and containing abundant eggs of intestinal parasites. Woodland plants and insects were rather common, probably because they were brought with moss used for sanitary purposes.

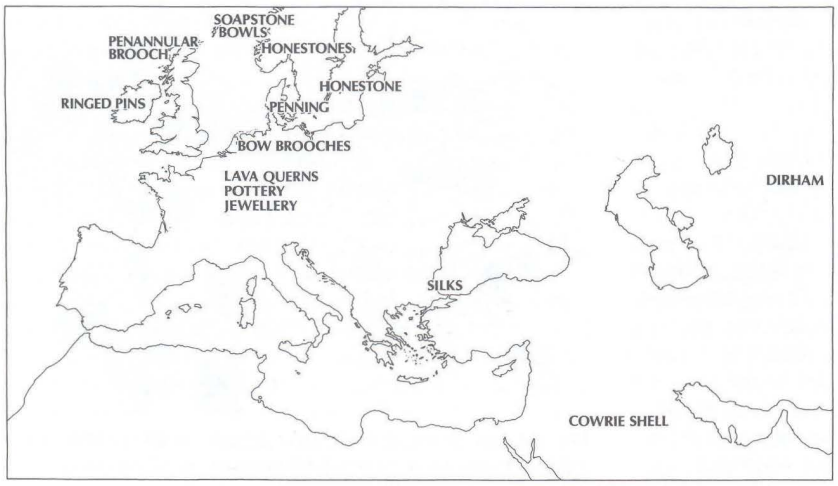
The presence of sheep lice indicated the presence of wool preparation and dyeing. Dye plants included madder and woad, and clubmoss from mainland Europe (see p. 333). Waste from the dyebaths formed thick layers in places. Bees were probably kept: they were often found, and were abundant in two deposits; honey presumably helped to make the sour sloes and other wild fruits more palatable. The animal bones and plant food remains have been extensively studied at York as on other urban excavation projects in Britain.

Technology and Trade

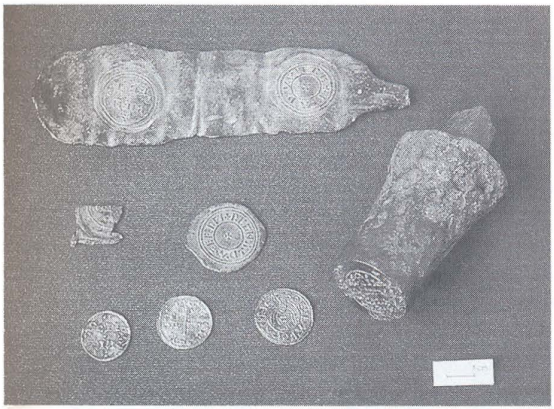
The excavations yielded extensive evidence for the practice of urban crafts, including a Roman workshop for the production of window glass. The most notable finds, however, came from the Viking deposits at the Coppergate site. Silverworking was an important industry, and was at its peak in the mid-10th century, although gold, lead tin, and pewter were also worked. Evidence for metal refining was found, both cupellation and parting (the separation of gold and silver), with crucibles and *tuyères*, ingot and object molds, and tools. The contemporary finds of coin dies suggest that much of the silver may have been used for coinage, possibly with moneyers working on the site. The coin dies themselves were made of iron and may be connected with the very extensive iron-working industry of the mid-10th century.

From the same area the abundant finds of textiles, including 221 specimens of fibers, cordage, and textiles of wool, linen, and silk, mainly from the Viking period, have given important insights into the textile industries of the period. Finds of loom weights indicate that the warp-weighted loom was in use. Much of the cloth produced was wool, but linen was also made, probably for bed-linen and undergarments. Dyeing materials such as madder and woad (see above) were recovered. It is clear therefore that the weavers were producing wool and linen cloth of good serviceable quality. The finer textiles may have arrived as a result of trade; the silks certainly were, perhaps brought by Viking traders from Russia, who were in contact with the silk route from China and Central Asia. Some at least of the silks are likely to be Byzantine.

These finds of metalworking and of imported textiles, and other indications including what were once interpreted as "trial stamps" for coins but are now thought to be customs receipts, allow a comprehensive picture to be built up of trading connections in the successive periods at York.



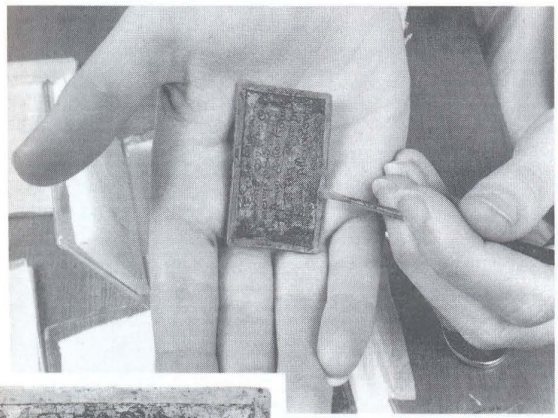
Viking York had extensive trade connections stretching across Europe into Asia. This map shows the principal sources of goods imported to Jorvik.



A coin die (right), lead trial piece, and silver pennies from 10th-century York.

Cognitive Aspects

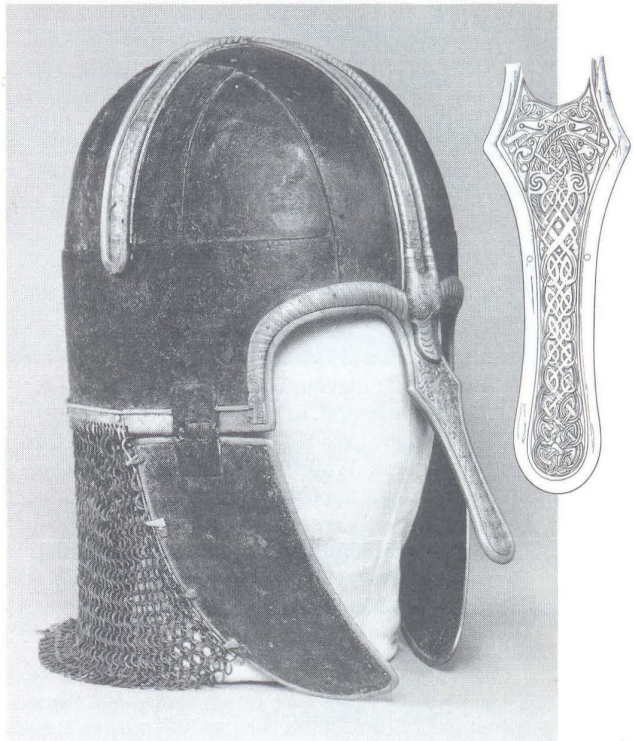
Since all four periods of urban development at York were periods of literacy, and since written records from each referring to York survive, in addition to the coins and inscriptions found during the course of the excavations, there is abundant evidence concerning the world view and thought processes of the population. Of particular interest were the medieval wax writing tablets found in a 14th-century rubbish pit – the 8 boxwood leaves had 14 waxed faces carrying scribed inscriptions – which turned out to be a risqué poem and a legal document.



One of the 14th-century writing tablets found at York. Each tablet was made of boxwood filled with wax, in which the text was inscribed.

One of the outstanding finds of the excavations is the Coppergate helmet, the focus of a meticulous study by Dominic Tweddle. The helmet dates from the 8th century AD, from the Anglian period, prior to the advent of the Vikings. It is one of a series of display helmets known from Britain and Europe, including one from the celebrated ship burial at Sutton Hoo. It is a work of superb technology – the neck was protected by chain mail and it has been shown that one defective link in the mail was meticulously repaired. It is possible to see this marvellous artifact as an intersection of the technical, social, and cognitive dimensions: supreme technological accomplishment and artistic skill used intelligently to convey and enhance the social status of a pre-eminent individual. The noseguard is a fine example of the animal-art interlace which is so notable a feature of the "Dark Ages" of northern Europe following the end of the Roman empire and of the centuries which followed.

The conservation of this important find was itself an involved process, and today it can be seen in the Yorkshire Castle Museum only a few hundred yards from its



One of the outstanding finds made in York is this 8th-century AD Anglian helmet, found at Coppergate; the noseguard was finely incised with an interlace design.

findspot in Coppergate. (It should be noted that the street names themselves carry a cognitive dimension – "Coppergate" meaning "Cup-makers' street" from the Norse *gata*, not the English "gate").

It is finds like these, and indeed the Sutton Hoo ship burial itself, which give us some of our clearest glimpses into the ethos of the heroic society of Britain and northern Europe in the centuries after Rome.

Whose Past? Public Archaeology in York

The first task of the archaeologist after excavation and initial research is to publish, but unfortunately often years pass before the full findings see the light of day. For that reason many excavators publish fairly full interim reports each year, immediately after the fieldwork campaign, and this was the approach followed by Peter Addyman following the early excavations undertaken by the Trust. However, he developed a novel approach, since adopted by many other projects, to the big problem of the Final Report. Rather than waiting for all the various specialist reports to come in before the final, heavy excavation volumes could appear, he resolved to publish the individual contributions as they arrived on his desk, in a series of briefer volumes or fascicules. Together these will make up 19 major, composite volumes in *The Archaeology of York*:

1. Sources for York History to AD 1100
2. Historical Sources for York after AD 1100
3. The Legionary Fortress
4. The Colonia (the Roman city, outside the military fortress, but within the city wall)
5. The Roman Cemeteries
6. The Roman Extra-Mural Settlement and Roads
7. Anglian York (AD 410–876) – i.e. the Anglo-Saxon period
8. Anglo-Scandinavian York (AD 876–1066) – i.e. the Viking period, until the Norman Conquest
9. The Medieval Walled City southwest of the Ouse
10. The Medieval Walled City northeast of the Ouse
11. The Medieval Suburbs
12. The Medieval Cemeteries
13. Early Modern York (from *c.* AD 1485 onwards)
14. The Past Environment of York
15. The Animal Bones
16. The Pottery
17. The Small Finds
18. The Coins
19. Principles and Methods

Elements of most of the projected volumes have been published over the past 25 years: including a series of pioneering studies in environmental archaeology.

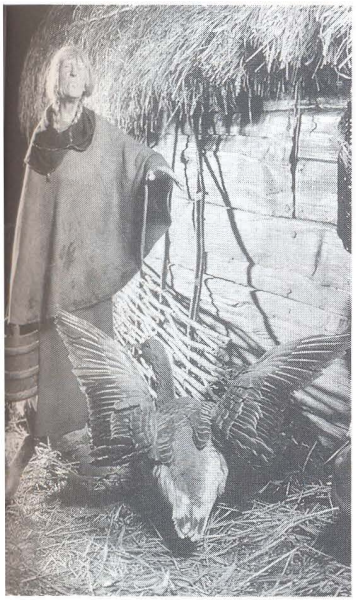
Probably the most notable feature of the work of the York Archaeological Trust, however, has been its success in involving the public – locals as well as an increasing number of tourists – using exciting new methods. Part funded with public money from local and national government, support has also come from property developers and, notably, from the millions of visitors who have paid to see the Jorvik Viking Centre. This is on the site of the original Coppergate excavation, incorporated at basement level beneath the commercially operated Coppergate Shopping Centre.

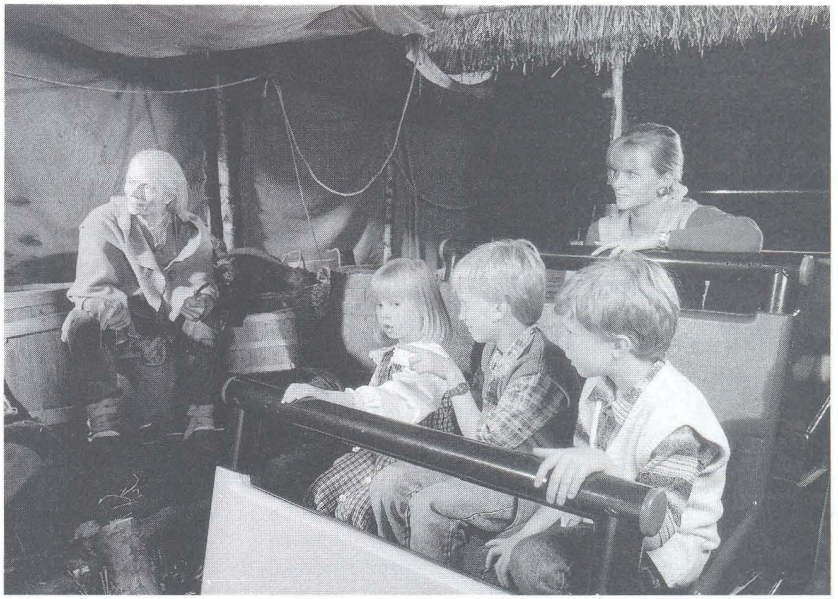
The Jorvik Viking Centre was a ground-breaking initiative which introduced innovative ways of communicating the results of archaeology to the public. The visitor first experiences an underground journey on a "timecar" through an authentic re-creation of the 10th-century Viking settlement, complete with skillfully devised sights, sounds, and smells, everything validated by careful research at York or using parallels from Scandinavia. This is followed by a part of the original excavation area and a walk through a small display of finds. In its first year of opening (1984) it had more than 850,000 visitors, and within 4 years the proceeds allowed the repayment (with interest) of the loan which had funded construction. This was pioneer archaeological entrepreneurism, and it has since been followed widely.

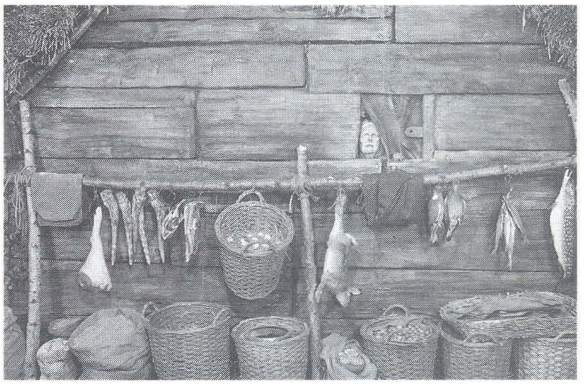
Its critics say that the "time capsule" approach of the Jorvik Viking Centre's underground "timecars" comes closer to Disneyland than to serious archaeology. But nearly all those who have undergone the "Jorvik experience," including archaeologists, say that they have enjoyed it and that they have learnt something – even if it is only how unpleasant the backyards of Viking Age York must have smelt.

In 1990 the Trust opened the Archaeological Resource Centre in the converted 15th-century St. Saviour's Church. Here school groups and the public can try hands-on sorting of finds, see researchers at work, and experiment with a variety of early technologies such as weaving and shoemaking. This too has proved very popular and now has 40,000 visitors per year. Finally Barley Hall is a restored and reconstructed medieval hall where visitors gain some experience of what life was like in 15th-century England.

The work of the York Archaeological Trust is a prime example of an archaeological project in an urban setting which is at once commercially and educationally successful, as well as academically productive. The Trust's continuing commitment to communicating the results of its work, and its pre-eminence in devising innovative and effective means to achieve this, are major contributions to public archaeology.







(Top left and right, and above) At the Jorvik Viking Centre visitors are transported by a "timecar" through Viking York, and can experience all the activities, sounds, and smells associated with life in the town at the time. Meticulously researched and based on both actual excavations at York and information from comparable Viking sites in Scandinavia, the Centre presents an authentic replica of 10th-century York. The York Archaeological Trust pioneered this method of presenting archaeology to the public, and it has since been widely emulated.

(Left) At the Archaeological Resource Centre in a specially converted 15th-century church, members of the public and school groups can find out what archaeologists do by sorting finds and watching researchers at work. This is another part of the Trust's innovative program of involving the public in archaeology.

FURTHER READING

The fundamental sources for the four case studies are as follows:

Oaxaca:

Blanton, R.E. 1978. *Monte Albán: Settlement Patterns at the Ancient Zapotec Capital*. Academic Press: New York.

Flannery, K.V. & Marcus, J. (eds.). 1983. *The Cloud People: Divergent Evolution of the Zapotec and Mixtec Civilizations*. Academic Press: New York.

Flannery, K.V. (ed.). 1986. *Guilá Naquitz: Archaic Foraging and Early Agriculture in Oaxaca, Mexico*. Academic Press: New York.

Marcus, J. & Flannery, K.V. 1996. *Zapotec Civilization. How Urban Society Evolved in Mexico's Oaxaca Valley*. Thames & Hudson: London and New York.

Kakadu:

Jones, R. (ed.). 1985. *Archaeological Research in Kakadu National Park*. Australian National Parks and Wildlife Service, Special Publication No. 13. Australian National University: Canberra.

Roberts, R.G. & others. 1994. The human colonisation of Australia: Optical dates of 53,000 and 60,000 years bracket human arrival at Deaf Adder Gorge, Northern Territory. *Quaternary Geochronology* (*Quaternary Science Reviews*) 13, 575–83.

Khok Phanom Di:

Higham, C. & others. 1990–93. *The Excavation of Khok Phanom Di, a Prehistoric Site in Central Thailand*. Vols. 1–4. Society of Antiquaries: London.

Higham, C. & Thosarat, R. 1994. *Khok Phanom Di: Prehistoric Adaptation to the World's Richest Habitat*. Harcourt Brace College Publishers: Fort Worth.

Kealhofer, L. & Piperno, D.R. 1994. Early agriculture in southeast Asia: phytolith evidence from the Bang Pakong Valley, Thailand. *Antiquity* 68, 564–72.

Thompson, G.B. (ed.). 1996. *The Excavation of Khok Phanom Di, a Prehistoric Site in Central Thailand. Vol. IV. Subsistence and Environment: the Botanical Evidence*. Society of Antiquaries: London.

York:

The main source of information is the series, edited by P.V. Addyman, *The Archaeology of York*, published by the York Archaeological Trust by the Council for British Archaeology.

Addyman, P.V. 1992. *York Archaeological Trust – 21 Years of Archaeology in York*. Annual Report of the Yorkshire Philosophical Society for 1992: York.

Hall, R.A. 1994. *Viking Age York*. Batsford/English Heritage: London.

Hall, R.A. 1996. *York*. Batsford/English Heritage: London.

Phillips, D. & Heywood, B. 1995. *Excavations at York Minster 1: From Roman Fortress to Norman Cathedral*. HMSO: London.

Phillips, D. 1985. *Excavations at York Minster 2: The Cathedral of Archbishop Thomas of Bayeux*. HMSO: London.